Marine Engineering

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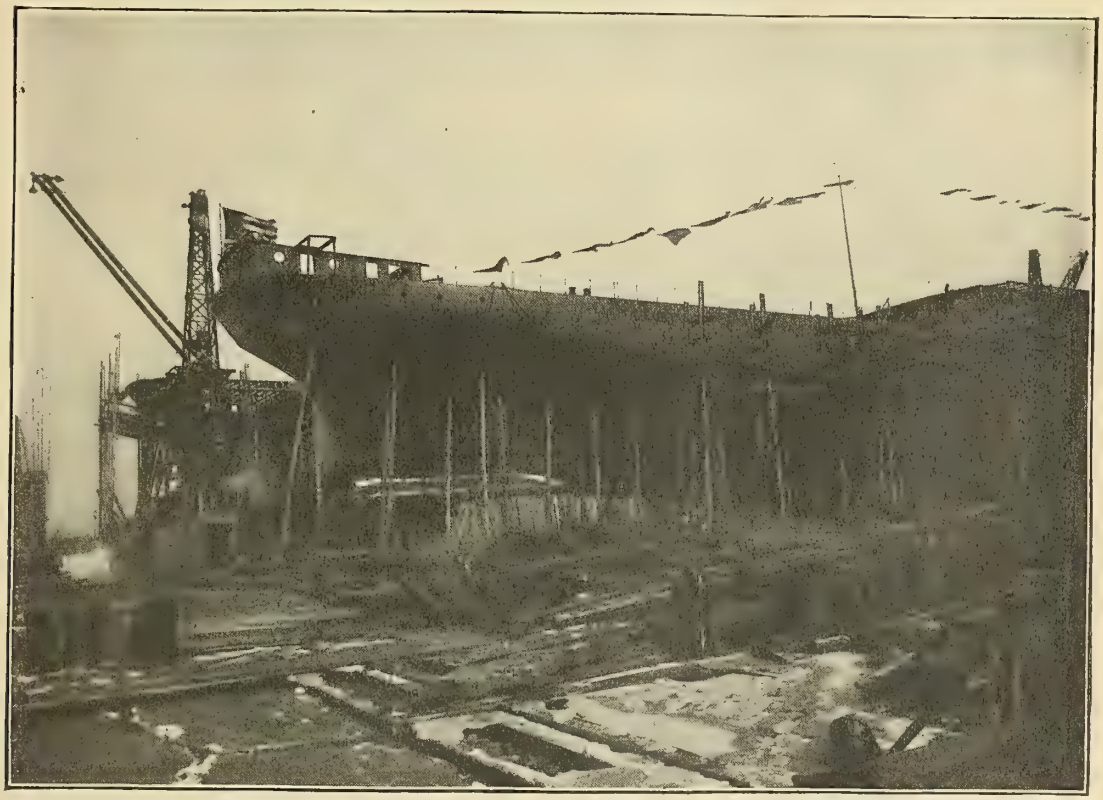
NEW SHIPS OF THE BOSTON STEAMSHIP COMPANY.

The Maryland Steel Company have under construction at their yard at Sparrow's Point, Md., two of the first cargo steamers of a large size ever constructed in this country. The contract for these steamers was placed by the Boston Steamship Company, of which Mr. Alfred Winsor is President, in the fall of 1900, and the ships are now ready for launching. They have a very easy model and will no doubt exceed expectations when on trial.

The general dimensions are as follows:—



STEAMSHIP SHAWMUT LAUNCHED ON DECEMBER 23RD FROM THE YARD OF THE MARYLAND STEEL COMPANY.

Length between perpendiculars	488 ft. 0 in.
Length over all	505 " 0 "
Beam molded	58 " 0 "
Depth to Main Deck	22 " 1 "
Depth to Upper Deck	32 " 1 "
Depth to Shelter Deck	40 " 0 "
Depth to Bridge Deck	47 " 6 "
Depth of Water Bottom	4 " 2 "
Draft Loaded	27 " 3⅛ "
Dead weight capacity	11 000 tons.
Designed speed loaded	12 knots.

The hulls are of mild steel throughout, built under the rules of the British Corporation Society for the highest rating. Special attention has been given to strength and precautions taken to avoid the weakness which has developed on previous ships of this size.

There are three complete steel decks extending all fore and aft, and a steel bridge deck for 178 feet amidships.

Nine hatches extend through all decks, those in the deep tanks being divided into two smaller hatches.

Four water-tight bulkheads extend to the upper deck and one to the main deck, forming a deep tank.

The fore and after peak bulkheads extend to the shelter deck. Two non-water-tight bulkheads extend to the main deck, one forward of boiler-room bulkhead, forming reserve bunker, and one between engines and boilers.

The double bottom is built on the cellular system and extends from the forward collision bulkhead to just forward of the after peak bulkhead. The capacity of water bottom tanks is 2,100 tons, and the deep tank has a capacity of 770 tons.

The framing is of the "deep frame" type, but a considerable saving in material and labor has been accomplished by using an 11-inch channel split at the bilge. There are three hold stringers on each side, consisting of two heavy angles with intercostal plate to the skin. In addition to these a stringer of the same construction has been worked between the main

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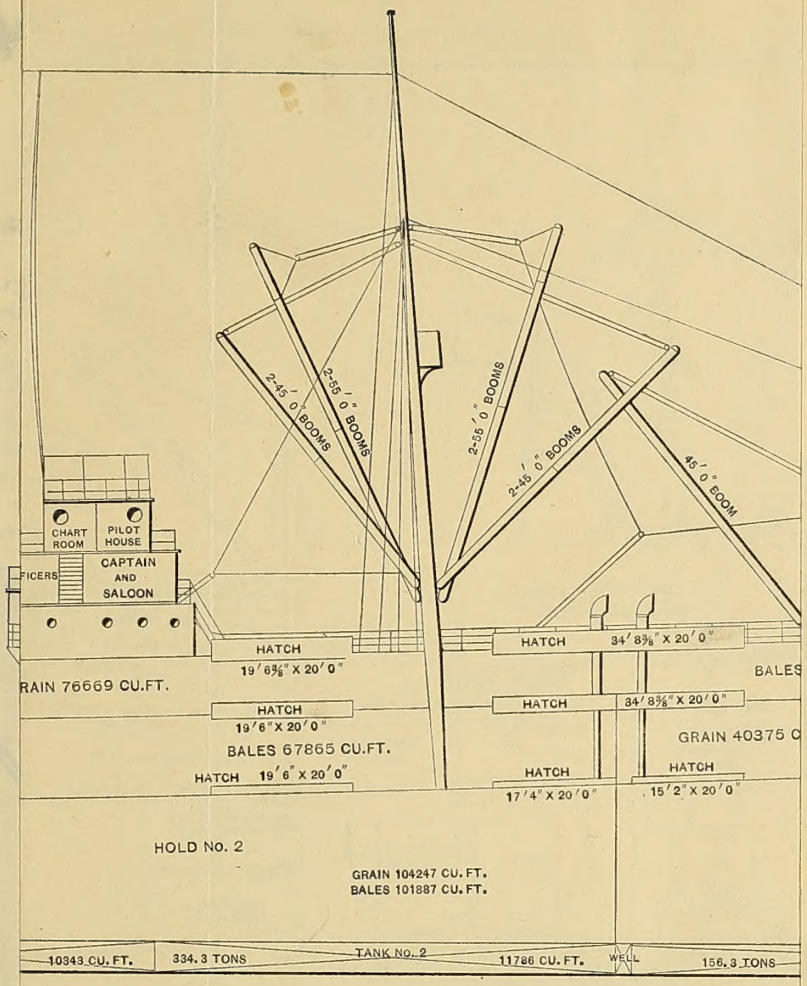
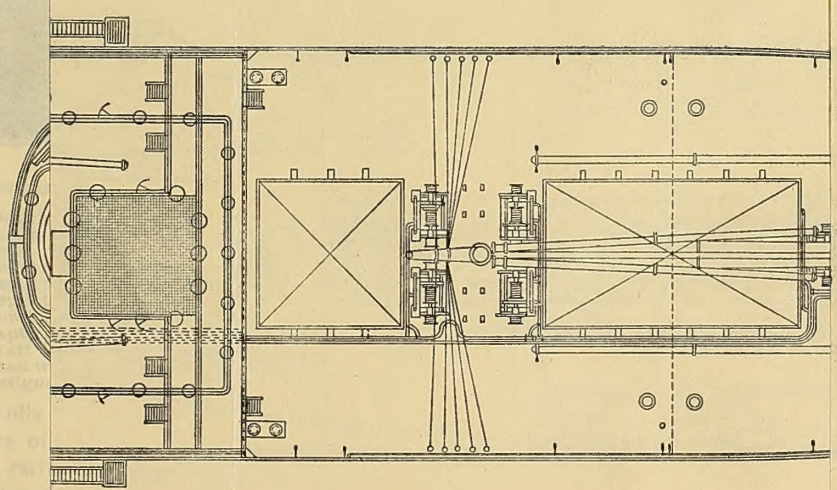
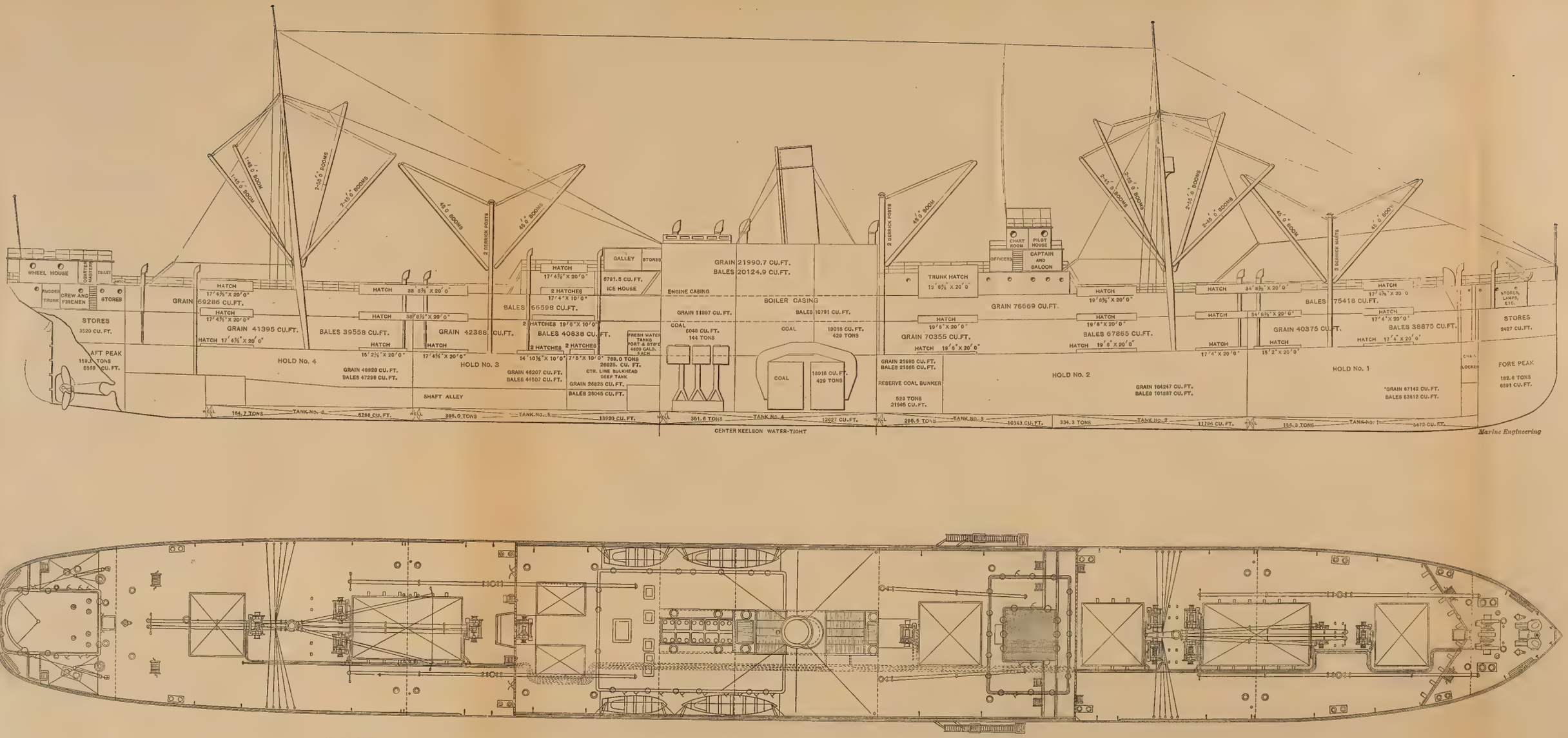




OR THE BOSTON STEAMSHIP COMPANY.

SUPPL



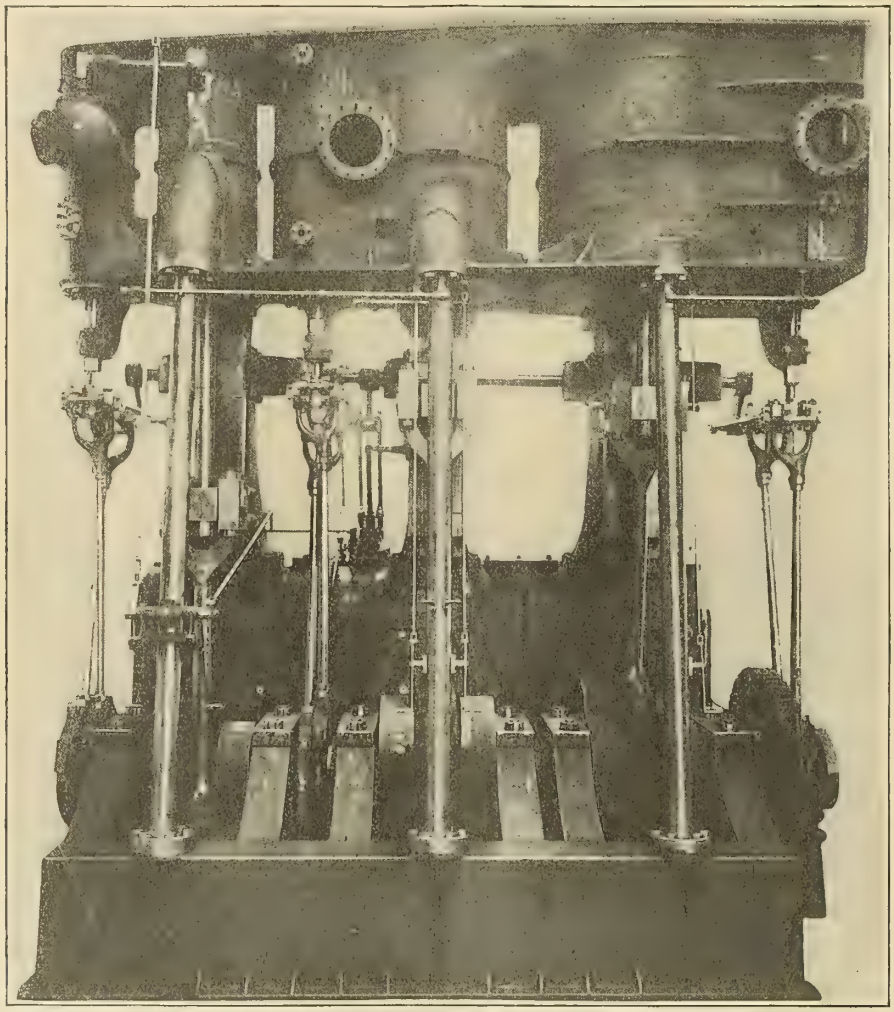
CAPACITY AND DECK PLANS OF THE TWO 11,000 TON FREIGHT STEAMSHIPS BUILT BY THE MARYLAND STEEL CO. FOR THE BOSTON STEAMSHIP COMPANY.

and upper decks, forming a very rigid structure. The deck beams are on alternate frames on the main and upper decks and on every frame on the shelter and bridge decks. The stem and stern post and hangers are of cast steel, and the rudder is forged and of the single plate type. The shell plating is arranged on the "clinker" system, doing away with the necessity of cement in the water bottom.

In stanchioning these ships the system of wide-spaced stanchions with girders under beams has been used, after the style adopted by Alfred Holt, and which

cers have quarters in the forward deckhouse, with large dining saloon, captain's toilet, pantry, two spare staterooms, linen lockers, etc.

A private stairway leads to the chart-room and pilot-house, which are situated directly over the dining saloon. The crew have large quarters under the shelter back aft, with stairway from the house above. This house also contains two rooms for quartermasters, and separate bathrooms and toilets for seamen and firemen. At the after end of the house is located the steering gear, which is of the Brown Brothers'



TRIPLE EXPANSION ENGINE OF THE STEAMSHIP SHAWMUT.

was extensively described in MARINE ENGINEERING for August, 1900. This greatly facilitates the rapid handling of cargo, and, taken in connection with the arrangement of booms and winches, should shorten the time of unloading considerably. The capacities of the different holds can be seen from the accompanying inset.

A complete system of ventilation is fitted to each hold and 'tween decks, intakes being fitted at forward end of holds and outlets at after ends.

The engineers have large quarters in the house on top of the bridge deck, which also contains the galley, pantry and toilets for officers and engineers. The offi-

type, with telemotor in pilot-house and on flying bridge above. There is also a docking bridge on top of the after house, with docking and steering telegraphs connected to the pilot-house and forecastle head.

There are two pole masts, each provided with two 55-foot and four 45-foot booms and six derrick masts, four of which have two booms each and two have one boom each. All derrick masts are provided with cowls for ventilating the holds. Twelve winches of Hyde make, 8 by 10 inches, are located on deck, arranged with a view to quick handling of cargo. The windlass and capstans are of the Hyde make, both being ar-

ranged with engines on the deck below. There are two capstans aft, one on each side of the deckhouse for warping purposes. There are three metallic lifeboats stowed on bridges alongside the engineer's house, two 30 feet long and one 20 feet long, also an 18-foot cedar dinghey. Anchors are of the Baldt stockless type stowed in hawse pipes. The anchor crane is of the type used on Government work, and will be kept in a stowed position.

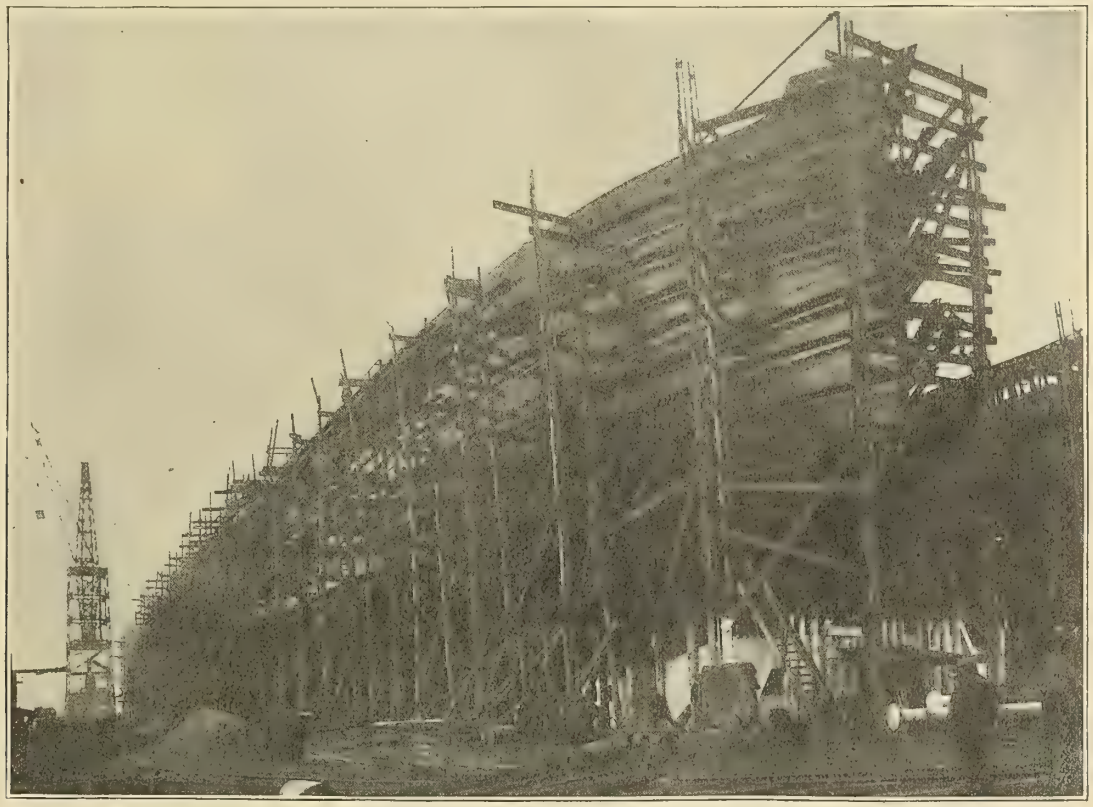
There is an Oregon pine deck on the bridge house and top of houses, and wooden ceiling over the bilges, no other wood being used for decking, and no spar ceiling being fitted.

forced in. The low pressure is fitted with double ported slide valves, with false face, secured with brass tap screws. A balance cylinder is fitted above the low pressure valve.

The valve gear is of the Stephenson link type, made of open hearth steel. The forks of eccentric rods and shaft arms are made of cast steel.

The reverse cylinder is a direct-acting steam ram, 12 inches diameter by 24-inch stroke, bolted to top and back of condenser, controlled by floating lever and with handle at working platform.

The crossheads are of open hearth steel, with cast steel shoe and composition gibs lined with white brass.



STEAMSHIP SHAWMUT ON THE WAYS, SHOWING TRAVELING CRANE TO LEFT.

The propelling machinery consists of two vertical, direct acting inverted cylinder, triple expansion engines, with cylinders 23 1-2, 39 1-4 and 63 inches in diameter, all having a stroke of 45 inches, and four single-end boilers 15 feet 6 inches in diameter by 10 feet 9 inches long, built for 200 pounds pressure. Each boiler has four 39-inch furnaces, giving a total grate surface of 276 square feet, and a heating surface of 10,752 square feet. The boilers are provided with Howden's forced draft, and are expected to provide steam for 4,000 I. H. P. under ordinary service conditions. The shafts are enclosed to the propeller in the well, known as the "Lundborg" style, and are in excess of the Registration Society's requirements.

The cylinders are of hard, close-grained cast iron, the high pressure having a liner forced in. High and medium pressure valves are of piston type with liners

The crank pin boxes are of cast iron, lined with white brass.

The back columns are box section of cast iron. Slides are of cast iron of slipper type, with cast iron keepers, and water circulation behind slide plate. Front columns are of forged steel. Eccentrics are of cast iron, with straps of cast iron, lined with white brass. Each condenser is in one piece, forming part of the engine frame, and is strongly ribbed. There are 1,196 tubes of 3-4 inch outside diameter, No. 18 B. W. G., tinned inside and out. These give a total cooling surface of 3,387 square feet to each engine.

The air pump is worked from the low-pressure crosshead and is of the usual vertical bucket type.

The thrust bearing is of the horseshoe type, with cast iron rings faced with white brass. Complete piping for water circulation is fitted.

The main steam pipe is of iron, lap welded, with semi-steel fittings and riveted flanges, all auxiliary steam piping being of copper.

Steam fire pipes are fitted to each hold, as required by law. The steam piping for winches and windlass is carried alongside the hatches on the shelter and bridge decks, and the piping for steering engine is carried through the shaft alleys.

There is a full equipment of auxiliary machinery. All pumps are of the Blake pattern. The other principal items are as follows:—

One Reilly evaporator of 35 tons capacity.

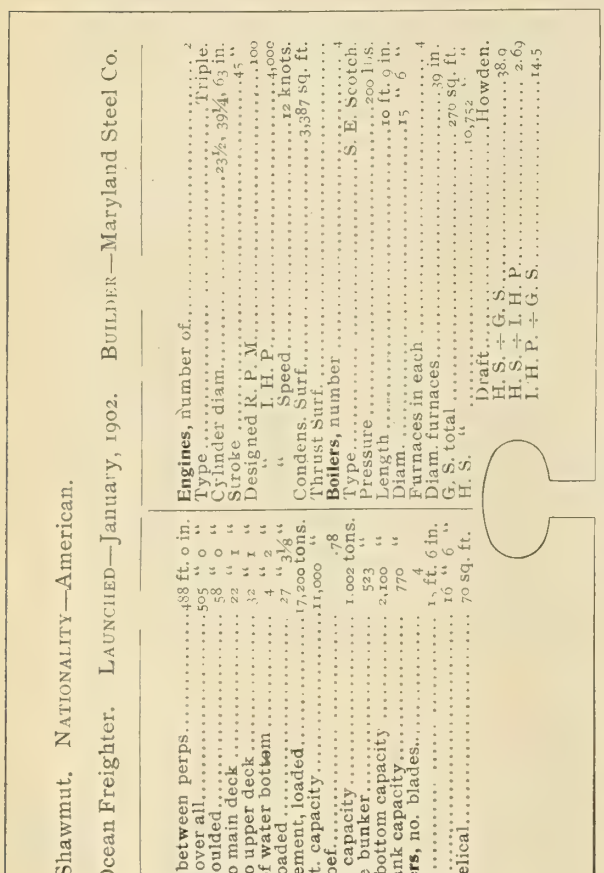
One Worthington feed heater.

Two 12-inch centrifugal pumps with 8 by 8-inch engines.

The electric plant is of the Sturtevant make for 300 16 c. p. lights, and is located in the thrust recess.

The propellers are of the built-up type, 15 feet 6 inches diameter, by 16 feet 6 inches pitch. The hub is of semi-steel and the blades of manganese bronze.

The second vessel is now completely framed, while the shell and deck plating are well advanced, and from present indications will be launched shortly.


NAME—Shawmut. NATIONALITY—American.
TYPE—Ocean Freighter. LAUNCHED—January, 1902. BUILDER—Maryland Steel Co.
Length between perps.....488 ft. 0 in.
Length over all.....505 " 0 "
Beam moulded.....58 " 0 "
Depth to main deck.....22 " 1 "
Depth to upper deck.....32 " 1 "
Depth of water bottom.....4 " 2 "
Draft, loaded.....27 " 3⅛ "
Displacement, loaded.....17,200 tons.
Dead wt. capacity.....11,000 "
Block coef.....78
Bunker capacity.....1,002 tons.
Reserve bunker.....523 "
Water bottom capacity.....2,100 "
Deep tank capacity.....770 "
Propellers, no. blades.....4
Diam.....15 ft. 6 in.
Pitch.....16 " 6 "
Area, helical.....70 sq. ft.
Engines, number of.....2
Type.....Triple.
Cylinder diam.....23½, 39¾, 63 in.
Stroke.....45 "
Designed R. P. M.....100
" I. H. P.....4,000
" Speed.....12 knots.
Condens. Surf.....3,387 sq. ft.
Thrust Surf.....
Boilers, number.....4
Type.....S. E. Scotch.
Pressure.....200 l.s.
Length.....10 ft. 9 in.
Diam.....15 " 6 "
Furnaces in each.....4
Diam. furnaces.....39 in.
G. S. total.....270 sq. ft.
H. S. " 10,752
Draft.....Howden.
H. S. ÷ G. S.....38.9
H. S. ÷ I. H. P.....2.63
I. H. P. ÷ G. S.....14.5

Passenger Steamer for Lake Michigan.—The Graham and Morton Company announces that they will build a large passenger steamer for service between Chicago and St. Joseph.

Explosion on Board the Royal Sovereign.—During firing exercises on board the British battleship *Royal Sovereign*, of the Mediterranean squadron, a 6-inch gun exploded, causing the death of one officer and five men, while three other officers and sixteen seamen and marines were more or less seriously injured. The court of inquiry formed to investigate the cause of the explosion ascertained that the breech screw of the gun was by some means immaturely swung to before the operation was concluded of inserting the safe arrangement, which should prevent such an explosion.

Submarine Boat Fulton.—The test of the submarine boat *Fulton* was recently made in the waters of Peconic Bay, when the little vessel with her crew on board was submerged and remained under water for fifteen consecutive hours and then came to the surface. The men reported that they were able to sleep and eat, had plenty of fresh air, and suffered no discomfort whatever. The boat, however, was at rest, her machinery not running, so that there were no internal conditions to produce discomfort, such as might be the case in active service.

Shipping of Hong-Kong.—The importance of Hong Kong as a commercial center can best be understood when it is stated that seventeen million tons of merchandise enter and leave the port annually, a greater foreign tonnage than that of New York. Over three million passengers are landed at Hong-Kong during the year. Since our fleet has become a fixture in far eastern waters a constant activity has been evinced by each of the commercial nations, realizing, as they do, that we have entered the far eastern situation to take from them, in open competition if we can, the trade advantages they have won.—*Iron Age.*

New Shipyard on the Lakes.—The Columbia Iron Works, at Port Huron, Mich., has acquired land on the St. Clair River, with about 1,400 feet frontage, preparatory to installing a modern ship-building plant. Good progress has been made in the grading, and pile driving will be carried on as the weather will permit. The buildings will be proceeded with as soon and as rapidly as practicable, and early in the season the plant should be ready for work on the two ships for which plans are now in preparation. These are a new type of grain carrier, 405 feet in length, and a lumber boat 180 feet in length.

Liquid Fuel.—At a meeting of engineers in Odessa, Russia, the engineer for the Russian Steam Navigation Company read an interesting paper on the subject of Oil Fuel for Steamers. He stated that Russia was the pioneer for the use of oil for propulsion at sea, as the vessels plying along the river Volga have for many years used *ostaki* or oil residue, for fuel in the boilers. Other vessels built in England for this company, equipped in burning coal, have had their furnaces changed for oil burners. He further states that after many experiments it was demonstrated that in the cost of the two fuels the cost of oil per mile amounted to only one-third that of the coal. Among the other advantages are, cleanliness, ease in regulating the amount of steam generated, saving of labor and waste. Similar experiments are to be carried out by the Russian Government.

NOTES ON THE EQUIPMENT OF FOREIGN SHIPYARDS.

BY PROF. C. C. THOMAS.

The Clyde is properly referred to as "The cradle of shipbuilding," and one finds there frequent reminders that many of the most prominent men of the professions of engineering and naval architecture have spent their lives developing the marine arts on the shores of that famous river. It follows, therefore, that there is, for the engineer, much of historical interest in the vicinity of Glasgow, and perhaps the Clyde presents more object lessons in the history of engineering than can be found elsewhere in the world. All along both banks of the river, from Glasgow to the sea, are shipyards and engineering works, many of them bearing names which are as familiar to the engineering world as is the name of the river itself. Each of these works, however, belongs to one of two general classes, which are, those which have kept up with the advancements in equipment and organization, and those which have not. The concerns are, as a rule, all of many years' standing, and one is surprised to learn that some of the largest and best equipped vessels have been built at yards, which at first sight at least, appear to be too poorly fitted out and too old fashioned in methods to attempt such work. Some yards do merchant work entirely, not attempting Government or large passenger contracts, and, of course, there are many concerns fitted up for building only the smaller classes of vessels.

It is not too much to say, and it is to be expected where there are so many competitors in a small section, that the greater number of the Scotch yards give the impression that the hand of prosperity has not opened bountifully over them, at least of late, and no doubt this impression becomes more real on account of a few among the number of shipyards and engineering establishments which do show such marked signs of resource and efficient and wide awake management. Among the latter class stand out pre-eminently the Clydebank Shipbuilding and Engineering Works, the Fairfield Ship and Engine Building Co., and the Engineering Works of David Rowan and Company. The latter company confines its attention to the building of engines and boilers for merchant service, while the two shipyards mentioned carry on the building of vessels of all kinds, from yachts and torpedo boats to ocean liners and battleships. These yards also build a great deal of the auxiliary machinery required in their contracts instead of purchasing it from outside concerns.

In these works, which are mentioned because they show what we may take to be the result of the most advanced opinions in Scotland of desirable engineering methods, while there are certain details of construction in the shops which are at variance with American methods, the improvements in the engine and boiler departments are mostly just such as our own large establishments are using. In fact, one finds many of our own improved tools in use on the Clyde, notably wood working tools, turret lathes, screw cutting machines, key seaters, and, in some cases, pneumatic chipping and caulking tools and pneumatic drills. Not many yards in Scotland, however, are equipped with compressed air plants, and those that are do little pneumatic riveting, the latter being a method of the utility of which the Scotch engineers are not yet convinced. In July last an exhibition of pneumatic riveting was given in the exhibition grounds at Glasgow, and was witnessed by various engineers and ship builders. The result was not favorable in the eyes of those present, as one at least of the rivets was found, upon cooling, to be loose, so that it could be twirled about in the hole. This called forth considerable criticism upon pneumatic riveting; much of the criticism being, no doubt, well founded, but in general based upon a quite limited knowledge of what had been done in that line in America. The writer failed to find many ship builders in England and Scotland who were favorably disposed towards riveting any portion of the ship with air tools, the chief objections being that the work could not be so well done, and that the economy claimed for the system was very doubtful, considering the compressors and small tools involved, which required frequent repairs. The same attitude exists among the builders in Germany, some of whom said they used the pneumatic tools only to frighten the men into not striking, but that, as a matter of fact, even for chipping and caulking they could do the work more cheaply by hand than with air tools, and that while it took a somewhat greater length of time, a better job could in most cases be done by hand. At the Vulcan Works, Stettin, however, the management is more favorable towards pneumatic tools, and contemplates the installation of whatever has been found successful in that line. In England, Scotland and Germany much of the heavier riveting on hulls is done by portable hydraulic tools, and for boiler work, of course, the hydraulic system is in use at all the large shops.

Returning to the Scotch yards, the principal difference between their best yards and ours, is in the methods of handling material from the shops to its destination on the ships. In the smaller yards the material is hauled, as of old, upon hand trucks over the ground from the plate and angle shops to the building ways, where it is hoisted into place by the help of tackle; the hoisting being done usually by a small steam winch. In the larger yards, narrow gauge tracks are laid from the shops to the ways, and hydraulic lifts are placed at various points along the sides of the ships. The material is transported from the shops to these lifts by means of small trucks running on the tracks, the trucks being moved by men or horses. An arrangement has been laid out in these yards so that cars from various railway lines may deliver material at the plate and shape stacks. From these stacks tracks run to the various shops, and locomotive cranes are used for handling material to and from the cars.

Exception should be made in the case of some of the yards on the Tyne, notably Messrs. Swan and Hunter, of Walsend, where one finds more labor saving appliances of modern type than are in use upon the Clyde. They are equipped with electric, hydraulic and pneumatic plants, and have experimented considerably with pneumatic riveting, but like many others, are disposed to confine the work of the pneumatic tools to drilling, chipping and caulking, as the

riveting seems to require an amount of collateral work which overruns in cost the economy due to the more rapid work of the hammers themselves.

Messrs. Swan and Hunter's yard is equipped also with sheds over the building ways, which carry overhead traveling cranes by which material is lowered into place upon the ships. These, with the large cantilever crane recently installed there, place this firm decidedly in the front rank among British ship builders; in fact, so far as the writer has seen, according to American ideas, the Walsend Works have a more modern equipment for handling material than any other yard in Scotland or England.

While in the less progressive and perhaps older yards the tools and arrangements are in many instances very much out of date, still in the works which are in Scotland and England considered up to date, the tools in the various shops are of the very best, and the relics have been set aside where they can be looked upon with reverence by the visitor, but they are retired from active service and their places are taken by modern appliances. In the older yards, however, patriarchs of fifty years are still at work in many cases.

In several of the engine works which have been, at least in part, equipped with new tools and improved overhead traveling cranes, the old buildings remain, and the head room is cramped. In many instances, in new as well as old shops, the vertical engines are erected in pits, so that they can be served by the cranes more conveniently and the engines are rendered more easily accessible for the workmen.

Germany has entered the field of shipbuilding upon a large scale in comparatively recent years, and the large yards are laid out according to modern ideas; the machine tools throughout are the best obtainable, and about the works is an air of system and organization that is perhaps the first thing that impresses the visitor. Prosperity in shipbuilding is more apparent in Germany than in Britain, though the equipments of the best yards of the latter compare favorably with those in the former country. There are, however, three yards in Germany of such magnitude, such excellence of equipment, and controlled by such progressive management, that they call forth the greatest admiration even from an American visitor. These yards are the Vulcan Works at Stettin, the Germanic Works at Kiel, and the Works of Messrs. Blohm and Voss at Hamburg.

There have been some very expensive works recently established at Vegesack and at Wilhelmshaven, which are fitted out with the most modern tools and handling devices, but of these works the writer knows only by hearsay. Mention should also be made of the Schichau Works at Danzig, where many of the smaller vessels of the German Navy have been built.

Messrs. Blohm and Voss occupy a most excellent position on a peninsula jutting out into the Elbe River, at Hamburg, and in one of the busiest parts of that crowded harbor. On account of this favorable location, repair work in great quantity comes to this yard, and the equipment of floating docks, graving docks, cranes and marine railways is capable of handling a great deal of this line of work. Their dry docks are among the largest in Europe. Messrs. Blohm and Voss employ in the neighborhood of five thousand men, and have in hand a large quantity of new work, among the vessels being the battleship *Prinz Karl*, and two large twin screw passenger and freight steamers for the Hamburg-American line. At these works pneumatic tools are not looked upon with favor, for reasons already given as coming from German builders, hence the air plant is little used, and not at all for riveting.

The great number of shipyard plate and shape working machines are operated by small steam engines directly connected to the individual machines, there being almost no belting employed in the shipyard sheds. The material for the hulls is handled in the usual way in the shops by overhead tracks and small cranes serving each machine.

The transportation of plates and shapes to the ships, however, is still done by the old fashioned means of small trucks, and it is hoisted into place by stationary pole derricks alongside the building ways.

Everything about the various departments of this establishment is of the best class and embodying the most modern improvements, with the exception of the devices for handling material from the shops to the ships. Messrs. Blohm and Voss have the third largest works in Germany and it is certainly one of the most efficiently organized and managed.

The largest works in Germany and that which has turned out the finest passenger steamers in the world, is the Vulcan Works at Stettin. Next comes the Germania Works at Kiel. At each of these works one sees material carried to its place upon the ships by overhead traveling cranes, which run on tracks carried in the tops of steel sheds build over the building ways. The sheds at Kiel are decked with glass, while at Stettin there is no covering over the ships, excepting the steel shapes of the building.

Of the works at Stettin, too much cannot be said in praise of the enterprise with which improved methods are being employed, and the general air of business and forehandedness speaks well for the utility of those methods.

At the time of the writer's visit at Stettin the *Kron Prinz Wilhelm* was about to leave for her trial trip to New York, the *Kaiser Wilhelm der Zweite* was partially in frame, and several battleships, cruisers and merchant ships were under way. At the Stettin Works are employed from six to seven thousand men, and at Kiel the number is from five to six thousand.

It is said that overhead cranes for shipbuilding ways were first built upon the Tyne, and that our American devices are developments due to the proverbial Yankee enterprise and ingenuity. Certain it is, however, that in many respects our American shipyards show far more machinery of modern type than do the British yards, and that the Germans are following in our footsteps in equipping their plants. In moving among industrial institutions in the older countries one soon finds that the name American is almost synonymous there with enterprise, economy and quickness of production. True, it is, that we find a ready market abroad for such articles as shoes, typewriters, electrical machinery of various kinds, and that we send large quantities of

steel billets, rails and various shapes—raw material, such as copper, tin and arsenic, and machinery in the form of locomotives and various machine tools. But let us remember that with all our labor saving devices, we have yet to show foreign vessel owners that we can build their merchant and passenger steamers for as low prices as they can get them in the British yards. Our prices are higher also than those quoted by German builders.

No doubt the facts that our labor saving appliances are quite new, and that the introduction of new methods takes time, that wages are higher with us, and that our yards are full of work for American owners, account largely for our higher quotations. Also just as the American workmen require higher wages than those in Britain and on the Continent, so the American proprietors probably figure on a higher percentage of profit in their contracts. American competition has become a very real thing to many industries across the Atlantic, but we must remember that while in the materials used in shipbuilding we have come to produce more cheaply, still in the finished product our costs are still too high to compete with foreign builders.

The above suggests that, before closing an article like the present, a few words should be said relating to the laborers, as well as the tools wherewith they work. The two principal factors determining the relative importance of countries in the commercial and industrial world are, the availability of supplies and the willingness of the people to work. Coupled with favorable natural conditions must be an energetic, enterprising people, or, in other words, industries demand industry. They are the products of the work of brains and hands, hence the personal peculiarities and habits of thought and action of the community determine what position it shall hold relatively to that of other communities equipped with natural resources commensurate with its own.

Skill in certain lines is the possession of the mechanics of certain countries, and those that have been engaged in particular industries for long periods have discovered and adopted methods of work which give them an advantage over later arrivals upon the field. In the manufacture of certain types of machinery and many articles of steady consumption we have come to produce so cheaply that other countries have not been able to meet our prices. This is attributed largely to the greater snap and energy of American workmen, and there is reason to suppose that by the adoption of methods for reducing cost of labor in shipbuilding and marine engineering we shall be able to turn out as large and fine ships as anybody, and at satisfactorily low costs. We are as yet far from having attained to this, however, which is no doubt largely due to the greater experience of the foreign engineers in the building of large work, their methods of standardization of machine parts, and the paying of workmen by the piece-work system.

Americans do not need to be told that in Great Britain one finds an energetic, ambitious working people, and that in any gathering of scientific men in England or Scotland, one has the honor of coming in contact with the sterling character and strength and culture of mind which make us proud to claim oneness of ancestry with them. Two elements, however, are militating against England's industrial progress, and nobody realizes better than the men in charge of institutions, that conservation on the one hand in adopting new methods, and trade-unionism on the other (preventing their profitable use when such methods are adopted) combine to prevent England from keeping pace with countries which have fewer traditions and less compunction about throwing away those which they find moss-grown. While the adoption or non-adoption of certain methods plays a most important part in determining what countries shall be the successful competitors, the question of first importance is the willingness and energy with which the workingmen further the interests of the concerns by which they are employed.

In some of the works which the writer visited, Friday was payday, and the men in the shops took certain liberties with their time on that day; Saturday was a half holiday, which seems to make more or less laxity necessary during the hour or so before quitting time, and on Monday there was less work going on than on either of the two days just mentioned. This left three days of the week in which full time was put in, and this state of affairs, which, happily has no parallel in America, seems to be due to the so-called independence which the men feel in relying upon their unions.

The questions which have been recently brought up in various publications concerning the reason that American competition is successful seem to be more nearly answered by the statement that we work harder, than by discussions of particular methods and systems, however important these may be. While we in America are confronted by serious problems, and can in no wise afford to rest upon our oars, our salvation lies in the fact that we do not ask for a chance to rest, but rather for opportunity to work harder and earn more money.

The unpleasantness of the past summer between labor and capital in this country, and many other instances, might be cited as challenging such a statement, but these volcanic eruptions have their origin in the ambitions in one class or the other. They bespeak a desire to get ahead rather than a tendency to do less work.

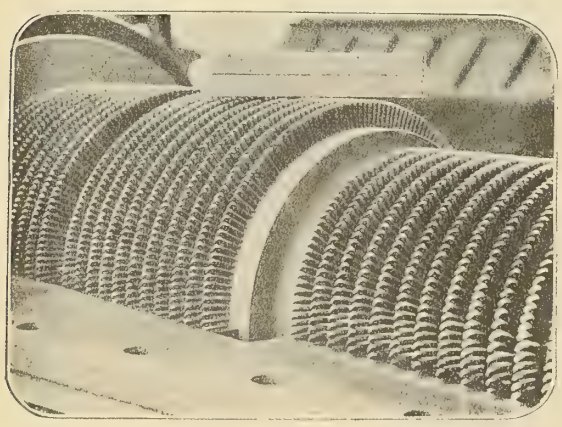
In general engineering production, England has long been a great factor; Germany has become a most active producer, and France is especially strong in certain lines. To the United States, however, the eyes of the industrial world are turned at present, as possessing the most promising combination of natural resources, brains and labor, together with a boldly progressive spirit in attacking and simplifying problems of engineering production. It is rather the combination of these desirable qualities that attract attention, than the possession of individual endowments of greater degree than other peoples. The last mentioned characteristic, however,—the boldly progressive spirit, or, in other words, lack of conservatism,—is generally believed to be more in evidence in the United States at the present time than in the other industrial nations.

TURBINE STEAMER KING EDWARD.

BY W. CARTILE WALLACE

Few if any innovations in marine engineering during the last quarter of a century have excited greater interest among engineers of every class than the application of the steam turbine to marine propulsion, more especially so since it was brought under the immediate notice of "the man in the street," so to speak, by the placing of the steamer *King Edward* on the Clyde during the early days of the Glasgow Exhibition.

While attending the Engineers' Congress, the writer, through the courtesy of the management, had an opportunity of spending a day on board this vessel and of becoming thoroughly conversant with her in every detail, and it has occurred to him that some information concerning this boat and the general impression her arrangements made on him might be of interest to the readers of MARINE ENGINEERING.



THE BLADES OF A PARSONS TURBINE.

It is hardly within the scope of this article to describe at full length the construction and working of the Parsons turbine, as its application to the driving of electrical generators dates back more than a decade, and its general principles are well known to engineers. But the improvements made since its first inception have been very great and the results correspondingly improved, so that from being considered one of the worst "steam eaters" it has come to be admittedly one of the most economical engines in existence.

The turbines fitted in the *King Edward* are those of the parallel flow type. This consists of a cylindrical case with rings of inwardly projecting blades, within which revolves a concentric shaft with rings of outwardly projecting blades. The rings of blades on the case nearly touch the shaft, and the rings of blades on the shaft lie between those on the case and nearly touch the case. Fig. 1 shows a section of the compound steam turbine as applied to the driving of dynamos. Fig. 2 shows one form of blades which is used. Steam entering at A (Fig. 1) passes first through a ring of fixed guide blades, and is projected in a rotational direction upon the succeeding ring of moving blades, imparting to them a rotational force. It is then thrown back upon the succeeding ring of guide blades, and the reaction increases the rotational force. The same process takes place at each of the successive rings of guide and moving blades. The energy to give the steam its velocity at each successive ring is supplied by the drop in pressure, and the steam expands gradually by small increments.

At the end of the spindle B are grooved pistons or dummies which fit into corresponding grooves in the cylinder. The object of these dummies is to prevent end thrust, and there is, therefore, a passage in the cylinder between each diameter of the spindle and the dummy of the same size. The dummies also act as a practically steam tight joint, since the clearance between the grooves can be adjusted longitudinally by a thrust block in the end oil keep. The bearings are of the tubular pattern, and, owing to the light weight of the revolving spindle, the wear is so small that the bearings often run for several years without being touched.

The turbine as applied to marine propulsion is so modified that the thrust of the propeller is entirely balanced by the internal action of the steam on the rings of blades. This reduces friction to a minimum, and only a comparatively light thrust block is required simply to steady the shaft and prevent the end play.

To return to the *King Edward*, her dimensions are: 250 feet length by 30 feet beam, by 10 feet 6 inches

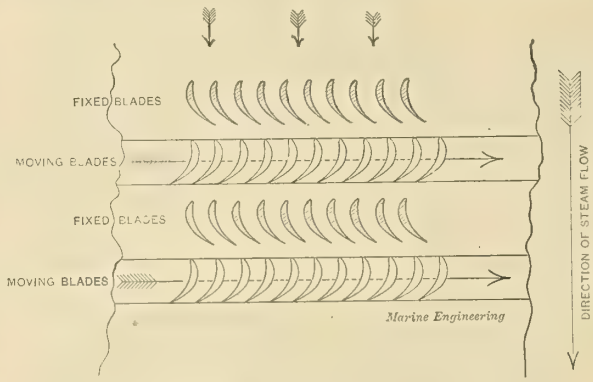


FIG. 1. SECTION OF STEAM TURBINE.

molded depth to main deck, and 17 feet 6 inches molded depth to promenade deck. Her general arrangements are somewhat similar to those of the usual type of modern river pleasure steamer as seen principally on the Clyde.

The machinery consists of three separate turbines driving three screw shafts. The high-pressure turbines are placed on the center line, the two low-pressure turbines each driving one of the outer shafts. Inside the exhaust ends of each of the latter are placed the two astern turbines, which are in one with the low-pressure motors, and operate by reversing the direction of the low-pressure turbines and outside shafts. Under ordinary running conditions these astern turbines work in the vacuum of the condenser and absorb no power whatever, this arrangement for reversing being by far the simplest and most effective of the many methods which have received the careful consideration of the patentee. When under way, the

steam from the boiler is admitted to the high pressure turbine, and after expanding about five fold it passes to the low pressure turbines, and is again expanded in them about another twenty-five fold, and then passes to the condensers, one of which is on each side of the vessel, the total rate of expansion being about 125 fold.

At twenty knots, the revolutions of the center shaft are about 700 and the two outer shafts 1,000 per minute.

There are five propellers in all, one on the center shaft, 4 feet in diameter, and two on each of the side shafts, 3 feet in diameter.

The small size of the propellers insures their being completely immersed under all conditions of weather, and it will be further seen by a little calculation that with a normal pitch ratio the slip per cent is not excessive for a vessel of this class at full speed. Mr. Parsons has found that in calculating actual steam consumption per indicated horse power (the resistance of the vessel being known from model experiments) the use of the usual coefficient of 55 per cent ratio of propulsive to indicated horse power gave results which practically agreed with the estimated consumption arrived at by other means, thus proving there was little if any loss of efficiency due to the small diameter of the propellers.

When coming alongside a pier or manoeuvring steam is shut off from the high pressure turbine, the outer shafts only are used, and the steam is admitted by suitable valves directly into the low pressure ahead or astern motors on each side of the vessel.

The center shaft with its turbine under these circumstances revolves idly, its connection with the low pressure turbines being closed by non-return valves. By this arrangement great manoeuvring power is obtained and the vessel is handled just as easily as an ordinary twin screw steamer, taking the piers without the slightest trouble.

While on board the *King Edward* the writer took particular notice of the facilities with which she was handled, both from the point of view of the captain and the engineer, and in either case there seemed nothing that could be desired. In the engine room the engineer has five hand wheels before him. The large one in the centre admits steam to the center high pressure turbine the two lower hand wheels at each side admit steam to the low pressure go-ahead turbines and those above them to the go-astern turbines. When the telegraph rings "stand-by" the engineer has only to give the center wheel a turn or two, thus closing off the steam from the H. P. turbine. He is then ready to receive his next order which may be "full speed astern," in which case it is only necessary to open the go-astern valves by means of the two side upper hand wheels and thus every order is executed by the turning of a couple of hand wheels to the right, say, and a couple to the left or *vice versa*. The whole operation is so simple that one engineer can handle both engines if necessary.

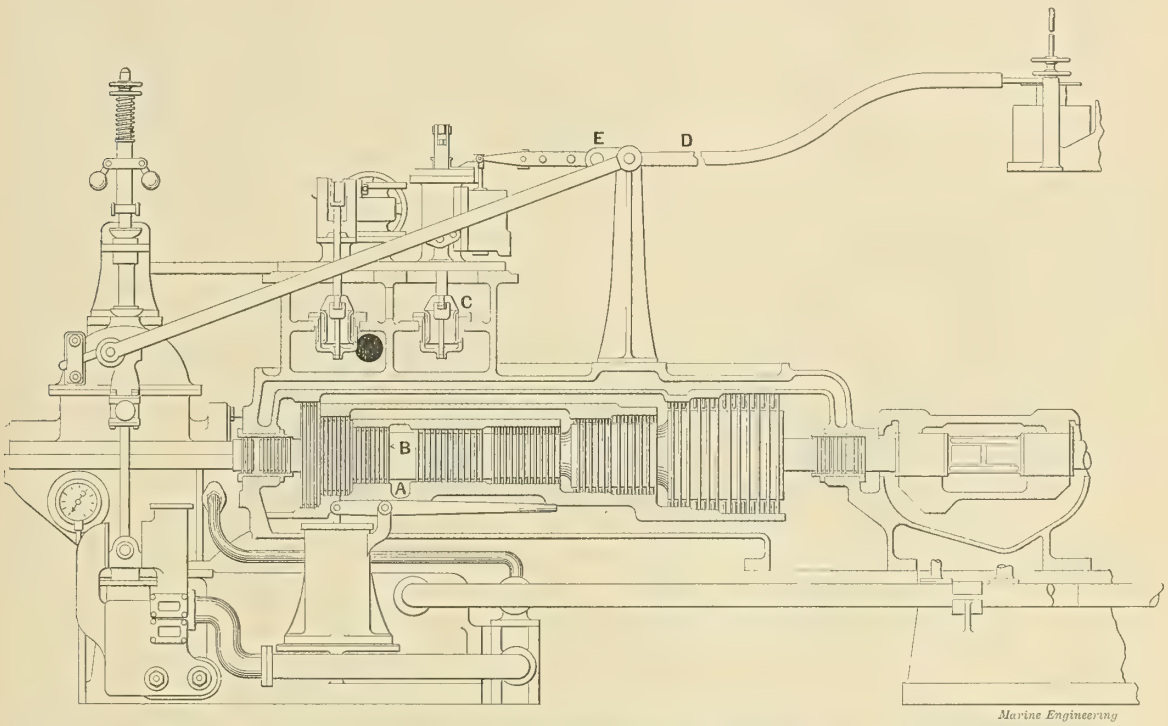
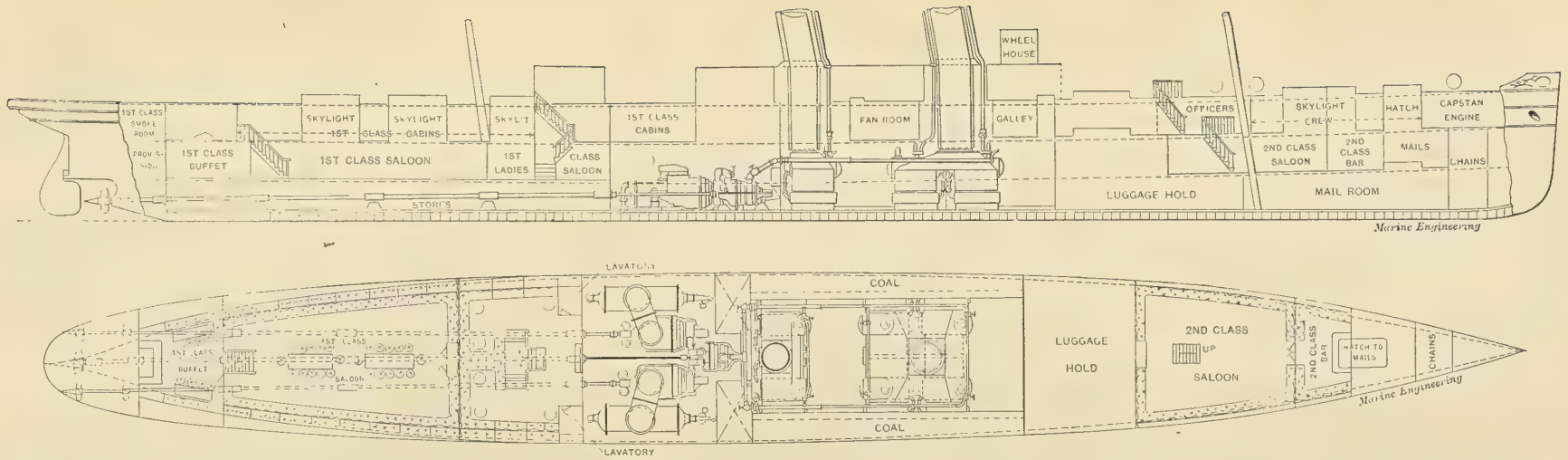


FIG. 2. SECTION OF PARSONS TURBINE SHOWING PATH AND DISTRIBUTION OF STEAM.

The main air pumps are compound and are worked by worm gearing from the main engines. There are also small auxiliary air pumps worked from the circulating engines for draining the condenser before starting. This arrangement seems to the writer unnecessarily complicated and might with advantage be replaced by a pair of the many combined air and circulating pumps on the market.



DESIGN FOR A PASSENGER AND MAIL CHANNEL STEAMER FITTED WITH TURBINE ENGINES. LENGTH OVER ALL 334 FT., ON WATER LINE 320 FT.; BREADTH MOLDED 35 FT.; DEPTH MOLDED 16 FT.; DRAFT 9 FT. INDICATED HORSE POWER 12,000; SPEED 25 KNOTS.

The lubrication is entirely automatic, the oil being continually circulated through the bearings by means of a pump driven by worm gearing. By this means very little oil is used and none wasted, the consumption of oil being much less than in an ordinary reciprocating engine of the same power.

Steam is supplied by a double end Scotch boiler of the usual type, 16 feet 6 inches diameter, and about 20 feet long, having four furnaces in each end, and worked under forced draught by means of closed stokeholds. This boiler with about one inch of air pressure in the stokeholds should give an average of 3,000 I. H. P. with triple expansion engines and good coal.

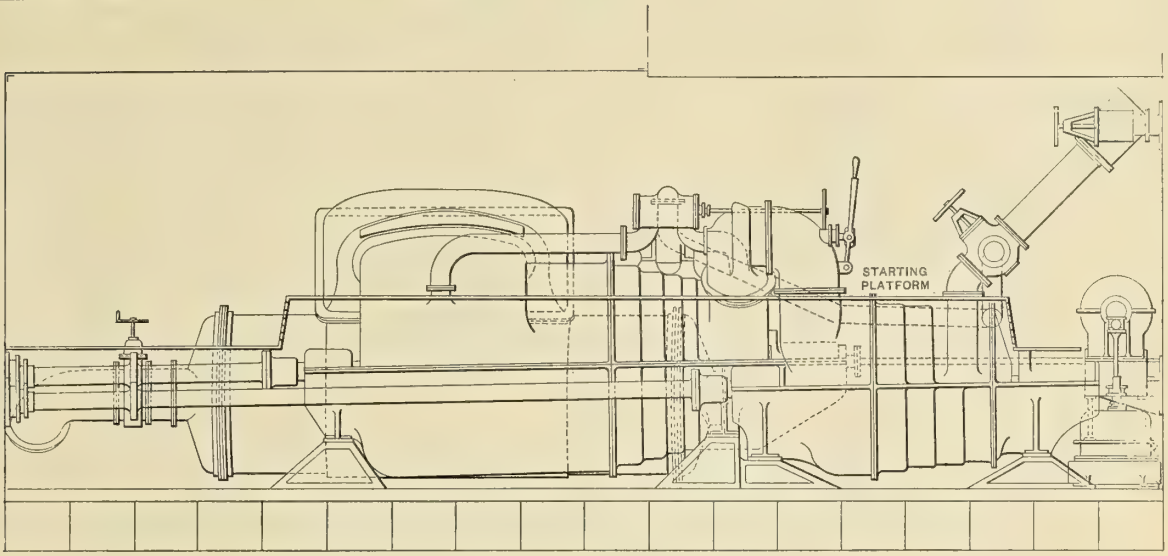
Judging from the speed which the *King Edward* can maintain, her wetted surface and coefficient of fineness being taken into account, it becomes apparent at once that the turbine engine cannot be using more than the usual amount of steam, and indeed the *King Edward* has proved herself a distinctly economical vessel of her class.

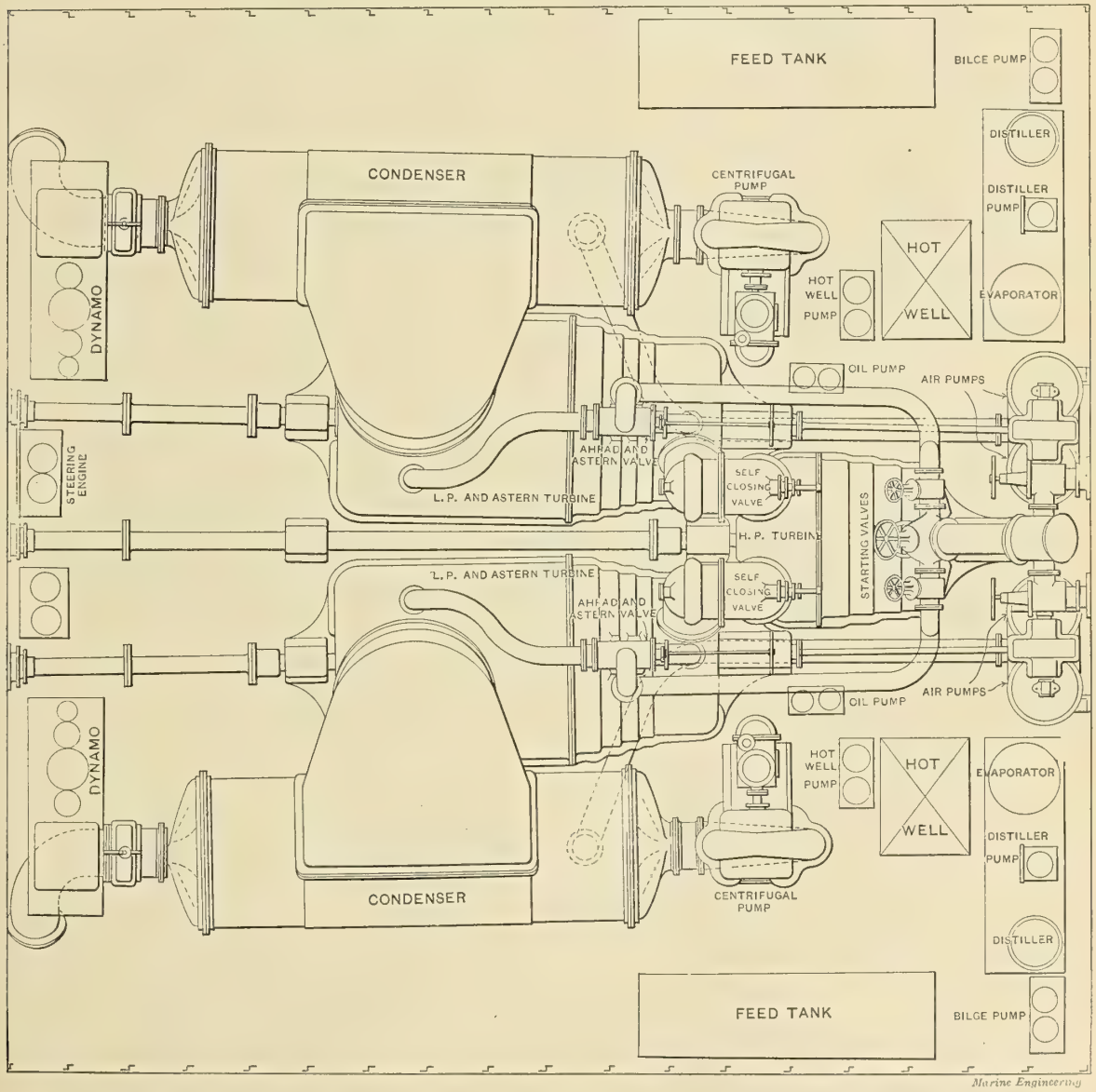
Comparing her with one of the well known Clyde steamers, the dimensions of which are practically the same, she, owing to less weight of machinery and greater available deck space, has a board of trade certificate for 300 more passengers, draws less water, is two knots faster, and burns less coal. Her consumption is estimated at an equivalent of 1.6 pounds of coal per I. H. P. per hour, whereas 2 pounds of coal per I. H. P. may be considered the average consumption for fast paddle river steamers.

The total weight of the machinery in the *King Edward*, including propellers, shafting, condensers, water, etc., is 80 tons, as compared with 200 tons as the weight of compound diagonal paddle engines of the same power. If we take the weight of the boiler and accessories of 170 tons, we get a total weight of machinery and boilers of 250 tons or 12 I. H. P. per ton (of 2,240 pounds.) With very large power and using water tube boilers and superheated steam, Messrs. Parsons claim that it is possible to obtain 16 I. H. P. per ton, this being the case it opens up possibilities of speed in crossing the Atlantic unthought of hitherto.

Another claim made for the use of the Parsons turbine is the absence of vibration. In this respect it is most interesting to note that for two thirds of the length of the *King Edward* taken from the bow, there was entire absence of vibration or noise of any kind, and this also applied to the engine room as far as the main engines were concerned. In the first class saloon which occupies the main deck, from aft of the engine space to the stern, a slight tremor was noticeable, and this, together with a humming noise, was more pronounced in the dining room which was situated under the main saloon and immediately over the propeller shafts. When standing on the counter there was most distinct vibration. This vibration is clearly traceable to the propellers, and was to some extent affected by the position of the rudder.

Taking into consideration the lightness of the hull of the *King Edward* and her comparative shallowness, the writer was forced to the conclusion that in an ocean going vessel of the same comparative speed there would be absolutely no vibration in that part of the vessel where saloon passengers are usually accommodated, namely, above the main deck forward of and around the engine hatch.





ARRANGEMENT OF TURBINE MACHINERY FOR A CHANNEL STEAMER OF 12,000 INDICATED HORSE POWER.

To any one standing in the engine room of this boat who is familiar with the high speed twin screw engine, it at once becomes apparent that the responsibility of the engineer on watch as far as the main engines are concerned is reduced to a minimum. The lubrication is automatic, as already explained, and as there is no pressure on the bearings beyond that due to the weight of the shaft, the likelihood of a hot bearing is almost nil.

During the early days of the turbine there were some unfortunate accidents due to the breaking off of some of the blades, which were then made of cast brass. Since the introduction of blades made from a wire drawn section of brass the breakage of a blade is practically unknown.

Another important point is, that experience has shown there is no deterioration or wear of the blades due to the action of the steam, whether superheated or otherwise, as some turbines in Newcastle have been running 16 hours a day for 12 years, and when examined with a microscope no alteration in the form of the blades could be detected. In practice it has only been found necessary to open up the turbine at long intervals, so that both at sea and in port much less attention will be required than is the case in ordinary engines.

There are what may be considered some minor advantages in the use of the turbine for marine propulsion, not the least of these being that no internal lubrication is required, as there are no rubbing surfaces in contact with the steam. Thus in a vessel where all the machinery was turbine driven there would be no possibility of oil getting into the boilers. The importance of this cannot be over estimated, as every marine engineer very well knows. In addition to this the absence of the necessity for lubrication enables superheated steam to be used at a temperature which would be fatal in the case of the reciprocating engine.

Further, the turbine engine is not affected by priming, the only effect being a temporary reduction of the revolutions, and no serious results would follow consequent upon the breaking of a shaft and the racing of the engines as in the event of the governor not acting promptly and water being carried over from the boiler, the very presence of the water would at once act as a break on the turbine and automatically check the revolutions.

Before concluding, I wish to give some figures which will emphasize the claim for economy made by Messrs. Parson and Co., which claim is the one of vital importance from the shipowner's point of view.

As a turbine engine cannot be indicated, it is necessary to have recourse to some other means of ascertaining the power which is being developed, and the simplest and most accurate of these is the determination of the amount of electrical energy developed by a dynamo when coupled directly to a turbine motor, and working backward from this known data, the I. H. P. necessary to produce this energy can be found.

A turbo-alternator manufactured some time ago at Heaton Works, Newcastle-on-Tyne, for the Corporation of Elberfeld in Germany, was tested by a committee of experts with the following results: At a full load of 1,200 kilowatts (1,610 electrical H. P.) and with a steam pressure of 130 pounds at the engine, and 18 degrees Fahrenheit of superheat, the engine driving its own air-pumps, the consumption of steam was found to be at the rate of 18.8 pounds per kilowatt per hour.

To compare this figure with those obtained with ordinary engines, assuming the highest record of the ration of electrical output to the power indicated in the steam engine, namely, 85 per cent, the figure of 18.8 pounds per kilowatt is equivalent to a consumption of 11.9 pounds per I. H. P.

Now with increased superheat and a more powerful engine, this steam consumption can be still further reduced. Indeed a turbo-alternator of 4,000 H. P. is now being manufactured by Messrs. Brown, Boveri and Company, of Baden, Switzerland, which has been guaranteed to consume not more than 10.2 pounds of steam per I. H. P., the steam pressure being 200 pounds and superheated to a temperature of 180 degrees Fahrenheit above the temperature due to that pressure.

In the face of these figures with engines of several thousand I. H. P. using steam at 200 pounds pressure superheated from 50 to 100 degrees Fahrenheit above the temperature due to the pressure, it is fair to assume an average consumption of 11 pounds of steam per I. H. P.

In last August issue of MARINE ENGINEERING some interesting information was given regarding the *Inchdune* and *Inchmarlow*, pointing out the advantages of superheated steam.

The writer, who has been specially connected with the carrying out of the boiler arrangement on these boats, can vouch for the fact that with Welsh coal it was possible to evaporate from the feed water at the temperature of the hotwell, and supply to the engines at a temperature of 50 degrees above that due to the pressure of the steam at 267 pounds, 11.7 pounds of steam per pound of coal burned under the boilers.

From this, it will be seen that with Parsons turbine engine, together with boilers similar to those in the *Inch* boats, fitted with Ellis and Eaves draught and Central Superheaters, it would be possible to get an equivalent of one I. H. P. on the main engine by the consumption of .94 pound of coal.

Another important matter, from a commercial point of view, is the relative cost of the turbo engines as compared with a high class reciprocating engine. In this respect we have the assurance of the Parsons Marine Steam Turbine Co., Limited, that at speeds of from 15 to 16 knots per hour the first cost of the turbine would compare favorably with the cost of an ordinary engine under similar conditions for the same I. H. P. For higher powers and speeds, turbine machinery would probably cost less than reciprocating engines.

There are many other applications of the turbines on board ship besides that of propulsion which will occur to a marine engineer, but the writer might say that he has recently fitted a turbo fan in connection with the application of Ellis and Eaves induced draught to water tube boilers, and has found it extremely efficient and satisfactory in working, not being affected by the heat of the uptakes and requiring no heavy foundations for support.

THE MECHANICAL EQUIPMENT OF MODERN SCHOONERS.

BY B. C. TUTHILL.

The tendency for the owners of sailing vessels engaged in the coasting trade to increase the size of their ships is induced by several reasons, the principal one of which is the fact that the cost per ton for running the vessel decreases, to a certain extent, as the size of the vessel increases. The gradual increase in size which has been taking place, and which has not yet reached its limit, is rendered possible only by the introduction of improved equipment in the form of mechanical appliances which inevitably forms a portion of the outfit of all large schooners of recent construction.

SIX MASTED SCHOONER GEO. W. WELLS.

(Copyright, 1900, by N. L. Stebbins, Boston, Mass.)

The six-masted schooners *Geo. W. Wells* and the *Eleanor F. Percy*, the two largest vessels of their kind afloat, are engaged in the coastwise trade, making regular runs between Norfolk and Boston, taking from three days to a week to make the passage, depending upon the weather.

The *Geo. W. Wells* is 303 1-2 feet on the keel, 345 feet over all, 48 feet beam, 25 feet depth of hold, and carries 5,000 tons of coal when fully laden. The *Eleanor F. Percy* is slightly larger, being 301 1-2 feet on the keel, 347 feet over all, 50 feet beam, 25 feet depth of hold, and carries 5,500 tons fully laden.

These vessels are fitted out with practically the same equipment and carry a crew, all told, of from fourteen to sixteen men each. Without the mechanical appliances with which these ships are fitted, it would require at least double the number of men they now carry to handle them, and no one would venture to build such vessels without the means at hand whereby the sails, anchors, ropes, etc., could be handled more easily and quickly than by hand.

The *Geo. W. Wells*, which is here selected as a type, is fitted out up to date in every respect, being equipped with two steam winches or hoisters, three steam pumps, a power windlass and capstan, a hand capstan, a steam boiler and a patent screw steerer.

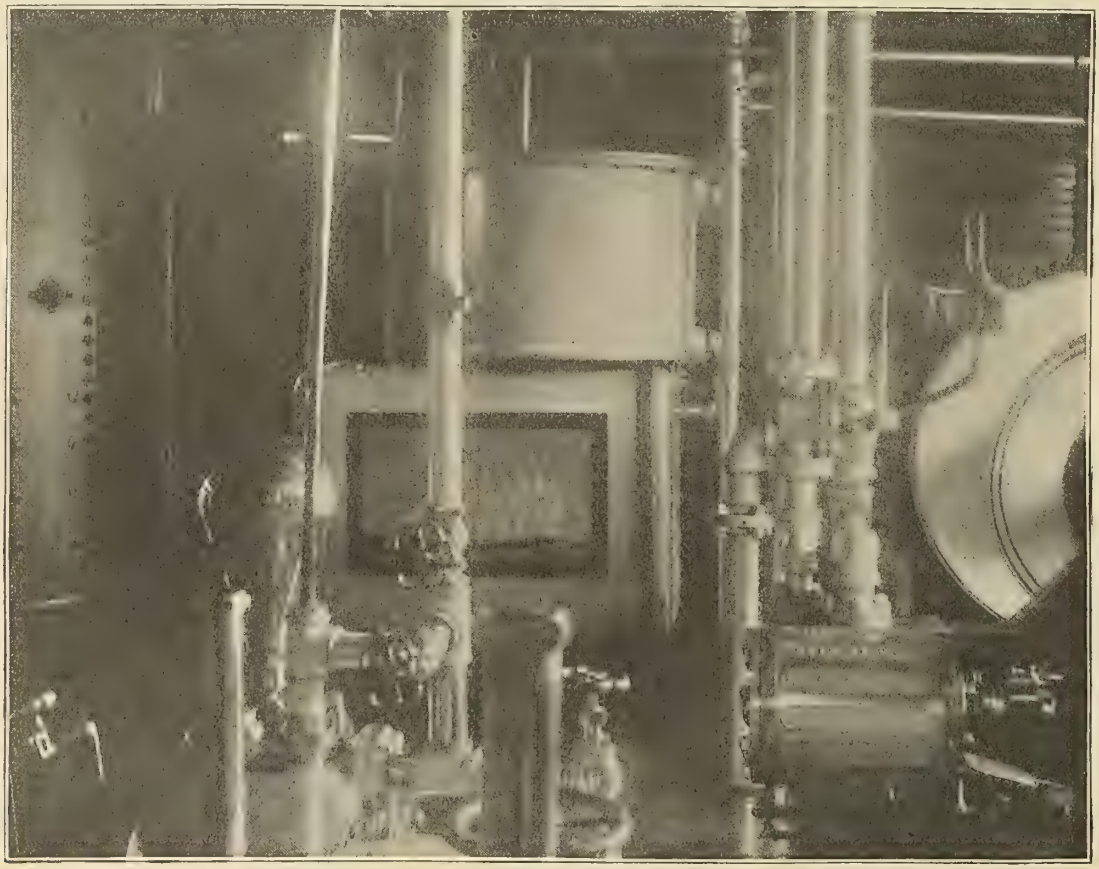
The engine room, which is located on the main deck just abaft the top-gallant forecastle deck, contains the boiler, one steam pump, the larger hoister, besides a feed tank and small condenser. The second steam pump and hoister is located aft on the poop deck, while the power windlass is forward, under the forecastle deck.

The boiler is of the vertical cylindrical type, 54 inches in diameter, 90 inches high, with tubes 5 feet 3 inches long and 2 inches diameter, the working pressure being 120 pounds. This boiler not only supplies steam for all pumps, winches, etc., but also for heating purposes, there being five radiators throughout the ship, three in cabin aft, one in the carpenter's workshop and one in the crew's quarters forward. Besides this, steam is used for heating water for the bathroom aft, and for washing purposes of the crew

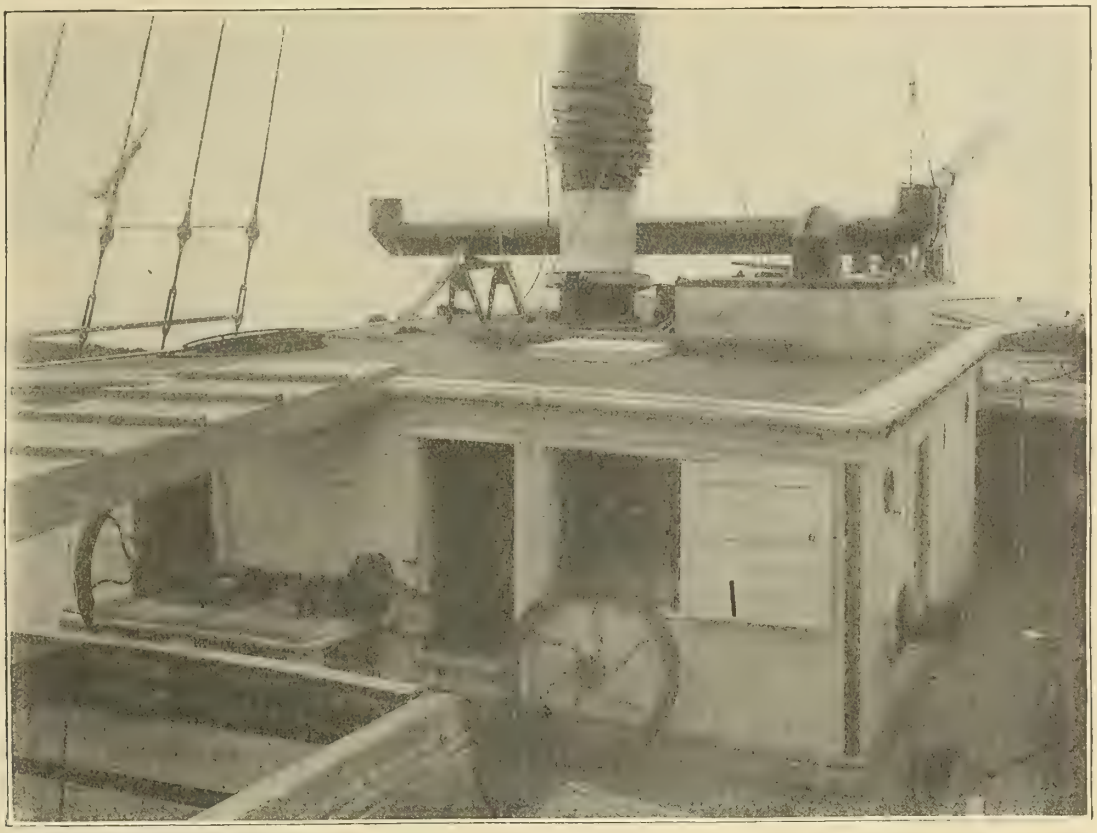
forward. Three pipes are carried aft along the main deck beams, one for steam to the hoister, pump and radiators aft, and one as an exhaust back to the condenser, while the third is a water pipe from the pump. A small pipe is also carried forward under the forecastle deck for heating the wash water for the sailors' use. Steam is kept on the boiler constantly, and in summer it consumes about 2 1-2 tons of coal per week, while in winter, when supplying steam for heating purposes, etc., the consumption runs up to about 5 tons per week. The boiler is seated on a cast iron base forming the ash pan, and securely bolted to the deck, with a layer of cement 3 inches thick between. The uptake is carried up through a square hatch with a heavy plate cover. About four feet above the top of the house it bends to a horizontal, and is carried forward until clear of the foremast, when it branches in a tee and is carried to port and starboard until on a line with the sides of the house, where it ends with a short upward bend.

The pump in the engine room is of the Worthington type, 6 inches by 4 inches by 6 inches, and is used as a service pump, supplying fresh or salt water, also as a circulating pump for a condenser, which is located just above the feed tank. This pump has a 3-inch bilge suction, a 2-inch sea cock and 1 1-2-inch fresh water suction, and can also be used as a feed pump for the boiler in case the two injectors with which it is fitted should fail to operate.

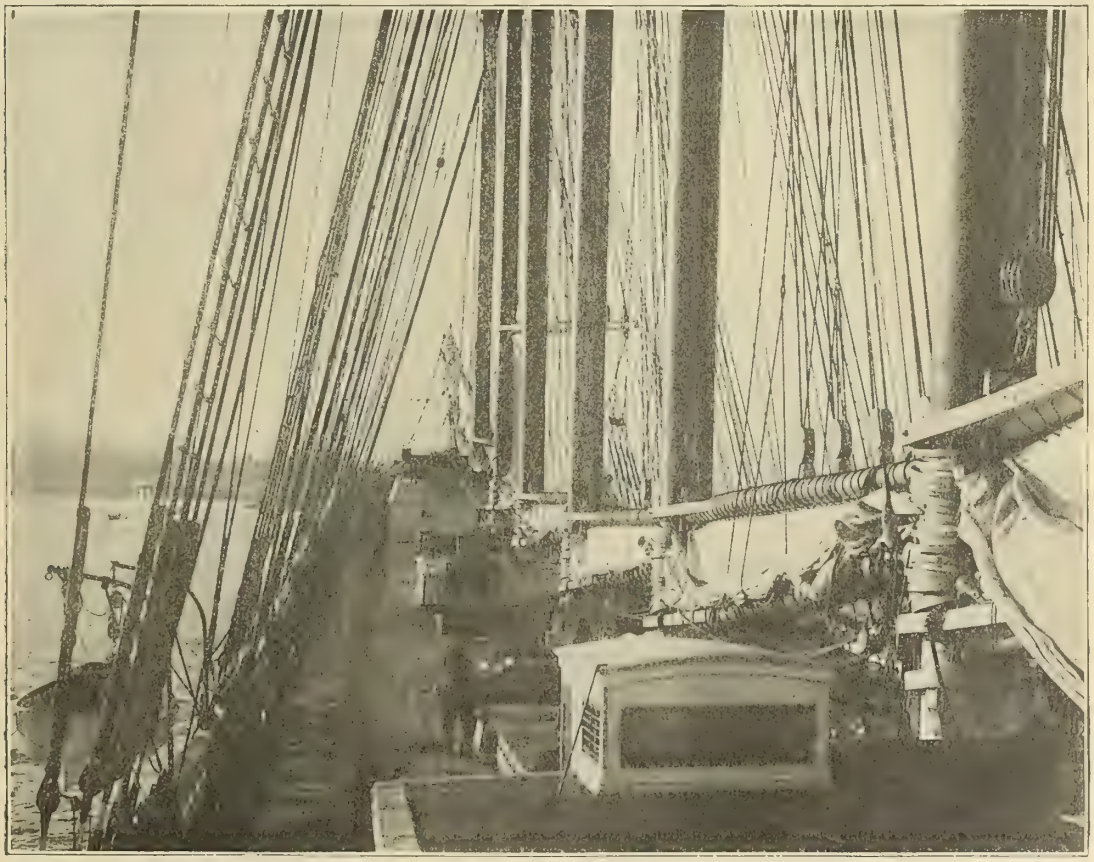
The large hoister, located in the after end of the engine room, is a Hyde, with cylinders 9 inches diameter by 10-inch stroke. The main shaft of this hoister is carried through the sides of the house and large winch heads fitted upon the ends outside. These heads are used in hoisting and handling all the sails on the three forward masts, including the head sails, the sheets, halliards, etc., being led to them by fair leaders or blocks located on the deck. Pull bells are used as a means of communicating signals to the engineer inside. The drum on the hoister itself is seldom used, except in cases where the vessel is compelled to do her own loading or unloading, the docks being usually supplied with the necessary appliances for handling the cargo, especially where coal is carried. Upon the main shaft of the hoister is located a wheel, close to the starboard side of the house, from which a messenger chain runs forward to a counter shaft located outside at the forward end of the house. A second chain connects the opposite end of this shaft with the main windlass, so that by means of a clutch located upon the shaft of the hoister this gear can be thrown in and the windlass operated by means of the hoister. A smaller shaft on the windlass can also be thrown into connection with this gear, whereby the power capstan on the deck above can be operated by the same means. A second wheel and chain is sometimes fitted to the shaft of the hoister for operating the large hand pumps, which, in this case, are located just



INTERIOR OF ENGINE ROOM ON A SIX MASTED SCHOONER.



ENGINE ROOM ON THE FORECASTLE OF A SIX MASTED SCHOONER.

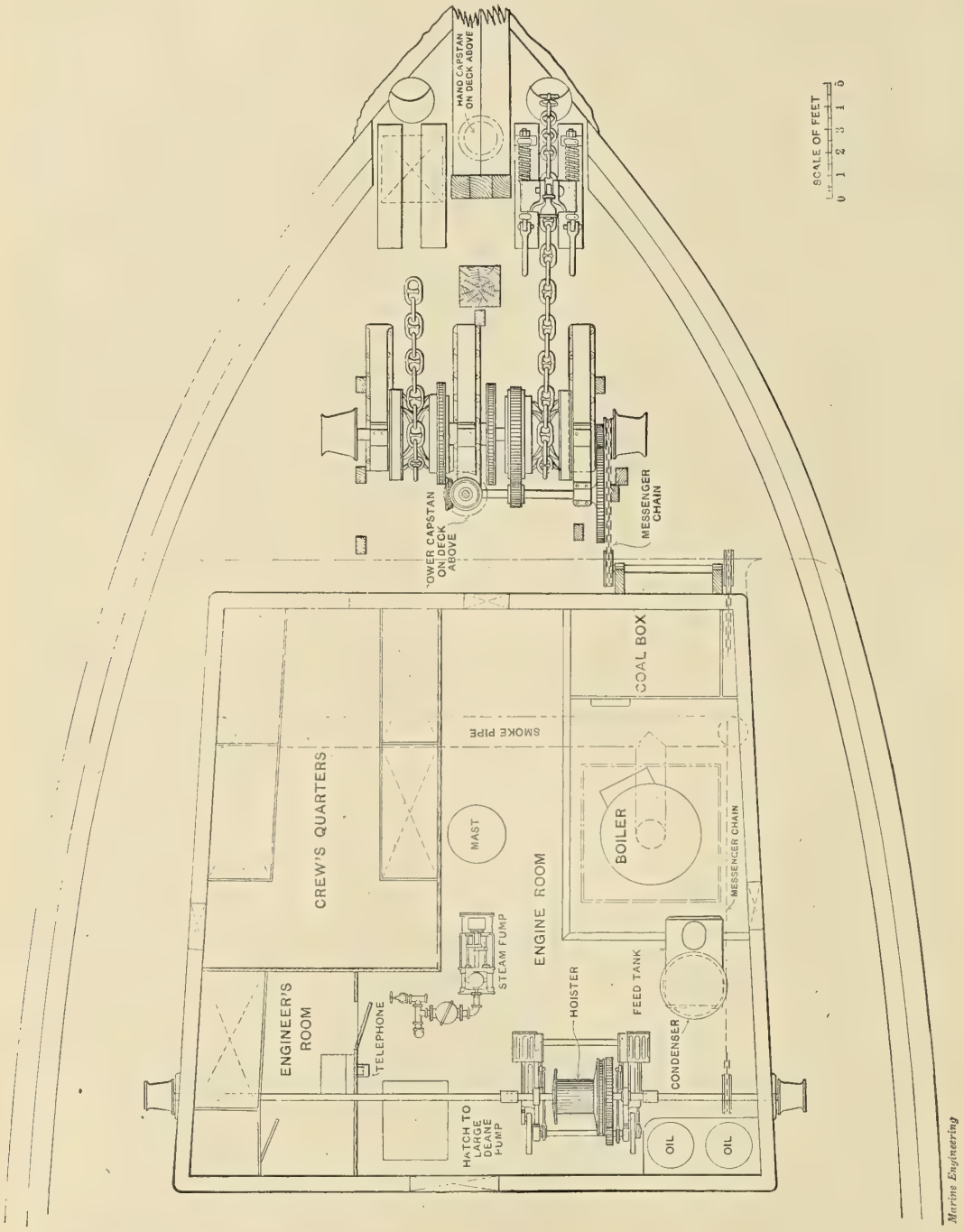


DECK VIEW LOOKING FORWARD ON A SIX MASTED SCHOONER.
(Photo by N. L. Stebbins, Boston, Mass.)

outside the engine room door on the after side of the house.

The main windlass can be operated either by power, as already explained, or by hand from the deck above, the hand gear being thrown in or out by means of a bilge and freeing the vessel of large quantities of water in cases of emergency.

The small steam pump aft is a Hyde duplex, 7 1-2 inches by 8 1-2 inches, by 6-inch stroke, and is located on the main deck at the forward end of the cabin. It



PLAN OF MAIN DECK FORWARD SHOWING ARRANGEMENT OF MACHINERY ON THE GEO. W. WELLS.

lever, which operates a peculiar form of locking device especially designed for the purpose.

Upon a flat below the engine room is located a large single-acting Deane pump with cylinders 12 inches by 12 inches by 12-inch stroke, to be used for pumping is auxiliary to the pump in the engine room, and is used principally in pumping bilges when the ship is down by the stern.

Besides the three steam pumps, the *Wells* has three deluge pumps, each having a 3-inch suction.

The *Eleanor F. Percy* has a Hyde hand pump, located on the poop deck just aft of the small hoister, which can be geared to the hoister by means of a messenger chain similar to the arrangement spoken of above.

The small hoister has cylinders 6 inch by 8 inch stroke, is located on the poop deck just abaft the fifth mast, and is used in handling all the sails on the three after masts. On the *Wells* the topsail sheets and tacks are handled by small hand gypsies located on the fife rail of each mast.

This vessel is supplied with the Hyde Robinson steerer, which has been fitted to most of the large schooners of recent construction. The steerer is a compact form of the double thread screw type, having a shaft with right and left handed threads, supported by two bearings, one being pivoted at the center of the rudder head and the outer or taffrail bearing being supported by wooden chocks on the deck aft of the rudder stock. The cap on the rudder head is made in two parts, and serves the double purpose of a crosshead and a clamp for the rudder stock, being tightened by bolts along the sides. This casting is also provided with a socket, to which an iron tiller may be fitted for use in case of accident. The connecting rods are slightly curved and form a direct connection between the nuts on the shaft and the crosshead, the usual guides being omitted. The taffrail box is in the form of a universal bearing so that it is always in line with the shaft. This prevents any undue friction or strain on the shaft. This bearing is arranged so as to have about three inches lateral play, the shaft being held in the mid position by strong coil springs acting on the ends of the trunnions of the bearing. By this arrangement any sudden shock coming on the rudder is taken up by the springs, avoiding the danger of springing the shaft. With this gear one man is able to handle the ship in all but the worst kinds of weather.

A telephone is fitted on the ship, running aft from the engine room, enabling the officer in charge to communicate directly with the engineer. This is a new departure in the line of schooner's fittings, and will undoubtedly become a part of the regular equipment, as it is found to be a great convenience.

The equipment of different schooners may vary somewhat, according to the size and ideas of the owners or builders, but the *Geo. W. Wells* represents the general method of fitting out practically all the latest built schooners of larger size constructed on the Atlantic Coast.

Erie Basin Fire.—On December 11th fire broke out in the boiler room of the John R. Robbins Company yard, at Erie Basin, Brooklyn, N. Y., destroying the boiler room and much valuable adjoining property to the extent of $100,000.

British Life-Savers.—In the report of the life-savers service on the coast of the United Kingdom for the year ending June 30, 1901, it is recorded that 152 lives were saved on 23 occasions of shipwreck, and that since 1870, 762 lives have been saved. There are at present 314 life-saving stations under the control of this board and no less than 3,770 volunteer surfmen.

The Steamer Hydrographer.

The steamer *Hydrographer*, the latest addition to the surveying vessels of the Coast and Geodetic Survey, has just been completed and turned over to the Survey by the builders, and is now at work in Chesapeake Bay. This neat and efficient little steamer was built by the James Reilly Repair and Supply Company, of New York and Philadelphia, who were the only bidders for the vessel at the amount appropriated. She is 101 feet long, 19 1-2 feet beam, 9 1-2 feet depth, and has a mean draught of 5 1-2 feet when full of coal and water. Her net tonnage is 79.26 tons. For her size she is probably the most efficient steamer afloat, as she carries coal enough to steam 1,600 knots at a speed of 10 knots, and easily makes 11 knots.

The frames are of oak, and planking yellow pine; she is fastened with locust treenails and composition spikes to 1 foot above the water line, and with galvanized fastenings above. All iron used in her construction is galvanized. She is classed A1 for 12 years by the American Bureau of Shipping, under whose inspection she was built.

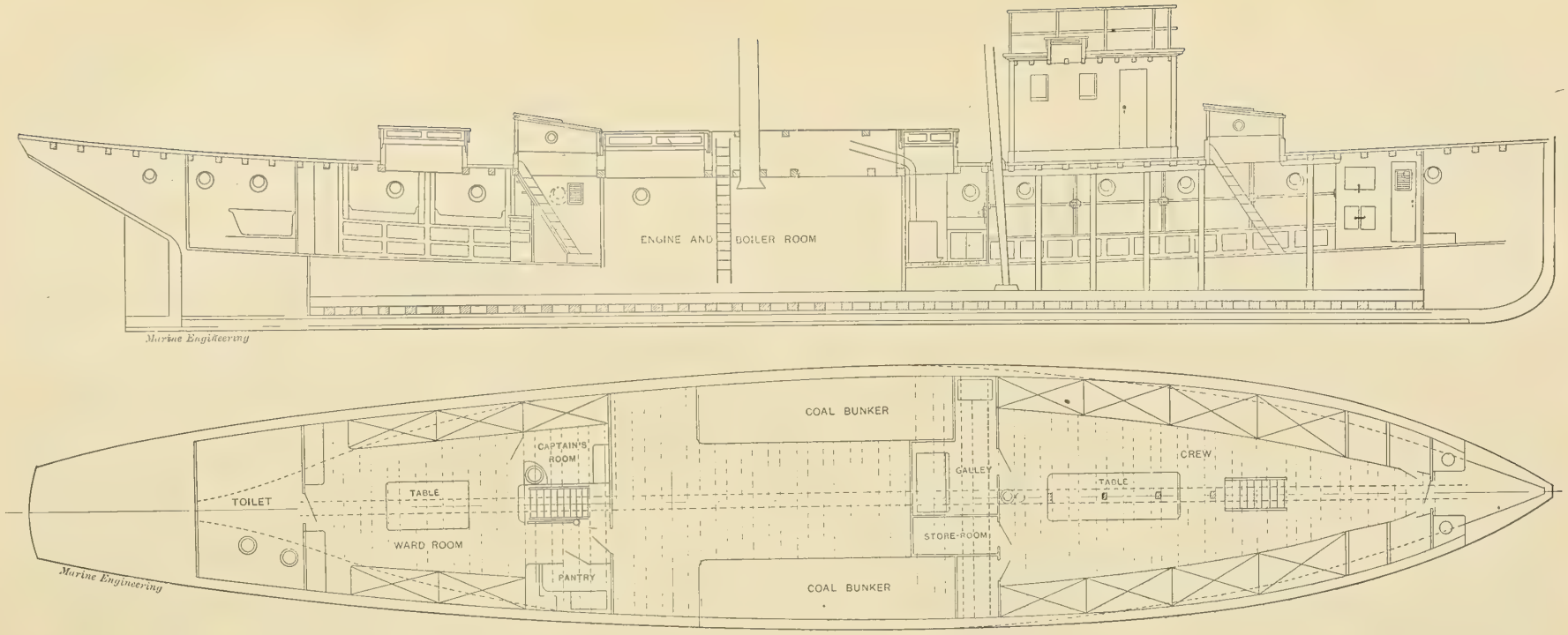
She has a triple expansion engine with cylinders of 9, 13 and 24 inches diameter and 14 inches stroke with Marshall valve gear, and develops 250 horse power. There are independent feed and circulating pumps, fire pumps, and feed pump besides independent feed pump and circulating pump for the evaporator and distiller. The Reilly evaporator has a capacity of 700 gallons of water in 24 hours for the boiler, or 500 gallons capacity for drinking water. The capacity of her water tanks is 2,300 gallons. A boiler of 250 horse power supplies steam at 250 pounds pressure to the engine and 100 pounds pressure to the auxiliaries, all exhaust steam being trapped to avoid a waste of fresh water.

The propeller is four bladed, 4 feet 8 inches in diameter, with 7 feet 8 inches pitch, and made 240 revolutions on the trial trip. When running 10 knots the revolutions are about 200.

The *Hydrographer* embodies some new features for so small a vessel; she carries one 26 foot and one 20 foot whaleboat, and a 13 foot dinghey, all of which stow on deck in heavy weather. As she is liable to be sent through inland waters and canals, guards extend along her sides to protect the boat davits. Baldt stockless anchors of 550 and 750 pounds do duty for the cumbrous anchors and gear usually fitted.

Her complement of five officers and sixteen men have commodious quarters, her berth deck being large, light and well ventilated, and heated by steam, pipe berths allowing a free circulation of air fore and aft. The fittings of the cabin are plain but neat, everything else being sacrificed to comfort and convenience for the hydrographic work for which the vessel was built.

The present work of the vessel is the collecting of data for the correction and revision of the Coast and Geodetic Survey Coast Pilot of Chesapeake Bay and Tributaries, and includes information relating to pilots and where they may be found, best and usual anchorages, depths in the channels, repair and supply facilities, quarantine, harbor and anchorage regulations, and sailing directions. All sailing directions are checked by running the courses with the vessel, and remarks are



ELEVATION AND PLAN OF THE U. S. COAST AND GEODETIC SURVEY STEAMER HYDROGRAPHER.

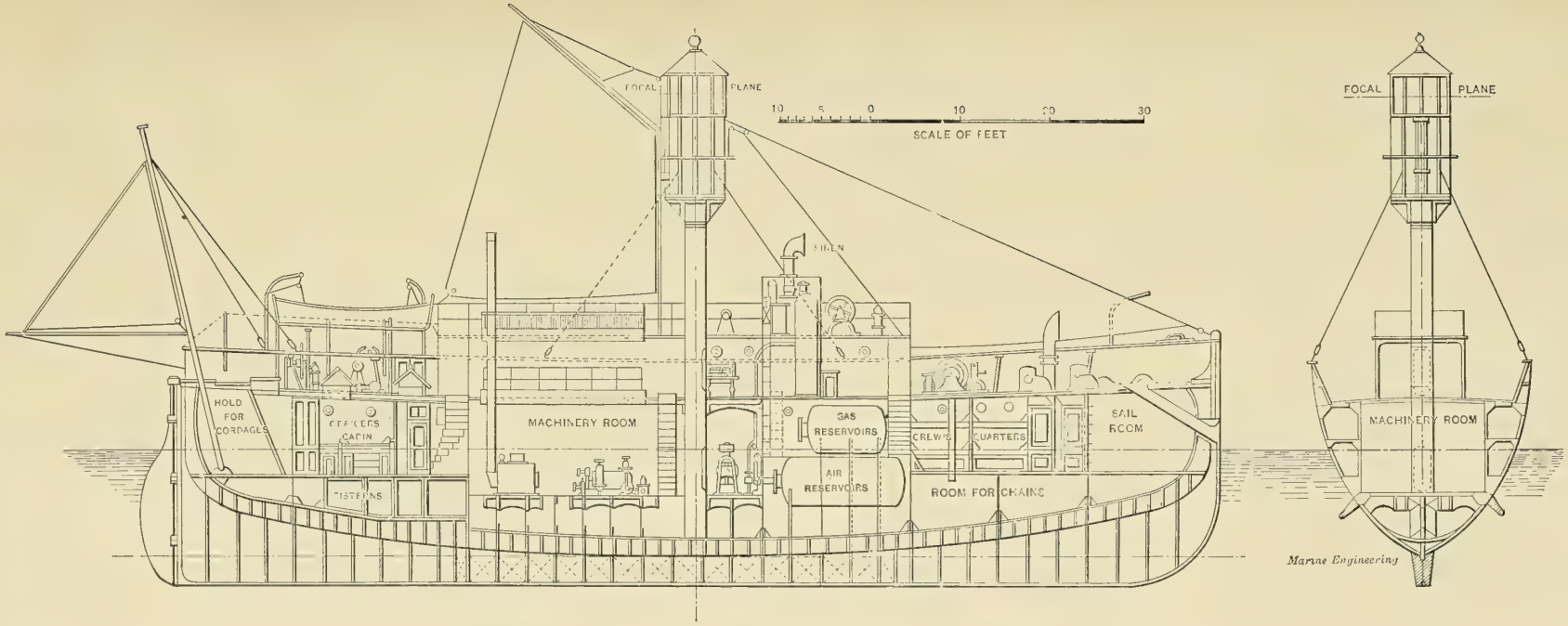
added relating to lights, buoys, and prominent features which may be of use to the navigator. Tables of lights and fog signals, tides, reporting and storm warning display stations, etc., are included, also the available data relating to tidal currents.

In addition to the data collected while on the vessel, any available information in the office at Washington, including the hydrographic and topographic sheets of the latest surveys, and information from the reports of the corps of engineers, U. S. army, are included. State and municipal laws relating to pilots and pilotage, quarantine and harbor control, the storm warning displays of the U. S. Weather Bureau, national quarantine laws and the regulations of the United States Marine Hospital Service, and the International and Inland Rules of the Road are included in the coast pilot appendices.

The *Hydrographer* carries a complete hydrographic party and outfit, and an important part of her work is the surveying of waters like Chesapeake Bay, where there are large shallow areas, for which she is particularly fitted because of her light draught and general handiness. She is also available for surveying work and special examinations in the shallow inland passages which are found along the Atlantic Coast from New York to Florida, and her draught and size permit her to pass inland from the eastern end of Long Island Sound to Ocracoke Inlet, and from Charleston, S. C., to Fernandina, Florida.

Shipbuilding on the Great Lakes.—The American Shipbuilding Company has now under contract 31 ships to be delivered during the next season of navigation.

German Shipbuilding.—Shipbuilding industry in Germany still shows unimpaired activity. In 1898, of the 21 steamships of 10,000 tons or over, then afloat, Germany owned ten, Great Britain six, United States four, and Holland one. This year there are sixty-one vessels of this size, of which twenty-four belong to Germany, twenty-six to Great Britain, six to the United States, three to Holland, and two to France. The contest for speed supremacy in transatlantic passenger and mail traffic has been abandoned by all the companies except those flying the German flag.



SECTIONAL ELEVATIONS OF NEW LIGHTSHIP FOR THE FRENCH COAST.

RECENT IMPROVEMENTS IN THE LIGHTING AND BUOYING OF THE COASTS OF FRANCE.

BY BARON QUINETTE DE ROCHEMONT.

The Lighthouse Department has within recent years inaugurated a new departure in lightship construction. In the first place it was found that the period of oscillation of the waves which materially affects the stability of a lightship, is fairly constant at each side of anchorage. Endeavors were consequently made to diminish the amplitude of oscillation of lightships; 1. By eliminating synchronism between the period of oscillation of the lightship and that of the waves acting upon it. 2. By reducing the rolling produced by the waves, by the addition of side keels to the vessel. This was done in 1890 and 1891, on the Dyck and Ruytingen lightships, of 290 and 338 tons displacement respectively. The period of roll of these lightships has been prolonged to four seconds; whereas the period of oscillation of the waves at the site is two and a half seconds. The period of four seconds has been arrived at by reducing the leverage of the metacenter in cross-section to less than 2.624 feet and also by increasing the transverse moment of inertia by placing pig iron ballast as far distant as possible from the longitudinal axis of the ship. The reduction or rapid cessation of the oscillations is produced by adding three keels to the vessel, the central keel being 3.28 feet deep, and the side keels 2.46 feet deep. The increase of stability thereby obtained is very marked. It has been still further increased by designing the other parts of the ship so that the waves have less effect upon it, and so that a greater force is required to incline the ship to a given angle, than was necessary with former types of lightships. This has been obtained by building recent lightships with a reduced section at the water line, and with a lower center of gravity, the displacement and periods of roll remaining the same, and the ballast consisting of pieces of cast iron attached to the central keel outside the vessel. The draught of the vessels has consequently been very much increased.

These arangements have been tried on two new lightships, the *Talaisand Snouw*, which, being less exposed, could be made smaller than the *Ruytingen* lightship, with 100 tons and 130 tons displacement respectively. The trials made with these vessels confirmed all expectations as to their stability, but they also showed that the *Snouw* was too small to withstand the waves of the open sea. Heavy waves swept its deck; and although they do not affect the vessel's stability, they render the work of the crew very trying.

* Extract from a paper read before the International Engineering Congress, Glasgow, 1901. Section II; Waterways and Maritime Works.

It is proposed, however, to remedy this by lengthening the hull.

The information afforded by these various trials and experiments has been utilized for the design of the lightship which is to be moored on the "Sandettie." These designs have been made by the Central Lightship department, assisted by Mr. Terre, *ingenieur en chef de la marine.* A series of observations taken during these consecutive months, July 11 to October 31, 1900, at the site proposed for the new lightship, show that the motion of the seat at this point is precisely similar to that at the anchorage of the *Ruytingen* lightship, and that the half period of oscillation of heavy waves is about two and a half seconds. The principal dimensions of the *Ruytingen* lightship, which has afforded satisfactory results, have therefore been taken as a basis, and modified, where necessary, in accordance with the results of the observations and experiments referred to above. The main dimensions of the vessel have, consequently, been fixed as follows:

Length over all	114 ft. 10 in.
Width at the water-line	20 " 5 "
Depth from deck to bottom of hold at center	16 " 8½ "
Depth from water-line to bottom of hold at center	11 " 9½ "
Projection of the keel and false keel in the middle	3 " 3 "
Mean draught, when loaded	15 " 1 "
Depth of side keels at center	2 " 7½ "
Displacement	342 tons.

The metacentric leverage transversely is 1.29 feet, and 99.58 feet longitudinally. The hull is divided into six compartments by five water tight partitions across the ship. The two compartments at either end are separated into an upper and a lower chamber by a wooden deck. The compressed air reservoirs for the sounding signal and the gas reservoir for illumination are placed in the third compartment from the bow; the boilers, the machinery for the sounding signal, and the coal bunkers are in the fourth compartment. The crew's quarters are in the second compartment, and the officers' quarters are in the fifth. The latter contains water cisterns of a capacity of 2,200 gallons. The end compartments, fore and aft, are used as storerooms for sails and ropes. The captain's cabin, the chamber for the sounding signal, and the cook's galley are placed on deck amidships, where the gangways leading down to the four central compartments are also situated. The lantern is carried on a hollow iron mast of 2.46 feet internal diameter; access is provided by two doors in the mast—one on the deck level and another in the machinery room. The sails consist of a jib and mainsail, the latter hoisted along an iron upright parallel to the mast, and of a jigger attached to a special mast. There are four anchors: a mushroom anchor weighing 4,400 pounds, two anchors of 1,540 pounds for the catheads, and a cast iron sinker of 264 pounds.

The mooring cables are 1.654 inches in diameter and 984 feet long. Two steel hawse holes are provided in the bulwarks for the sheet anchors. Another cylindrical hawse hole, in the center of the bow, connected with the stem slightly above the water line when loaded, is provided for mooring the ship. Two small lifeboats are provided, 19.68 feet and 18.86 feet long respectively, provided with air chambers.

The illuminating portion consists of a swinging optical apparatus for a lightning-light giving out white flashes at regular intervals of five seconds. The optical apparatus, which has four panels of 9.84 inches focal distance, is provided at the lower part with a rod carrying a counterweight. This rod is fixed by means of a Cardan joint, below the apparatus, in the center of a horizontal ring rolling on steel ball bearings and operated by the rotating machine. Another counterweight is placed at the top of the apparatus. This apparatus weighs 1,540 pounds and is so designed that its center of gravity is 0.591 inches below the point of suspension. Under these conditions, the period of a single oscillation of the apparatus is about eight seconds. The difference between this and a half period of a roll of the ship is such that the divergence of the apparatus from the vertical is less than five to six degrees, and the illumination is not affected thereby. The illuminant for incandescent lighting is compressed oil gas. It is conveyed through a pipe running up the mast, and when it reaches the top it passes through a mercury joint into a small tube, which turns exactly at the same rate as the apparatus by means of a train of wheels operated by the rotating machine. This small tube is connected by a rubber pipe to the lower end of the apparatus, which has a hole running up the center for the passage of the gas to the burner. The illuminating power is 3,500 carcels. The gas is stored in three reservoirs, which are tested at a pressure of 112 pounds; two of the reservoirs have a capacity of 8,240 cubic yards, and the third a capacity of 6,801 cubic yards.

In addition to the illuminating apparatus, the lightship has to be provided with equipment for the sounding signal. This comprises two boilers with distilling plant, condensers, and air compressors; and a single siren worked by compressed air, with reservoirs and accessories. The boilers and condensers are also used for working the steam windlass on board. These boilers are of the type adopted for the 50-horse power engines of scouting or despatch steam launches of the French navy; they have an internal fire box, a direct flame, with forced draught by means of a steam jet into the flue, and a distilling boiler tube. The self-condensers have a single cylinder steam engine, which operates an air pump, two feed pumps, the pumps for the recupérator of distilled water, and the centrifugal pump for maintaining the circulation of the water. The air compressing plant consists of a steam engine working a compressing pump with two pistons and a pump for maintaining the circulation of the sea water. The compressing pumps are designed to work at will, either at a pressure of 210 pounds or at 28 pounds.

The sounding signal is a single note siren, requiring 14.12 cubic feet of air per second; the pitch of the note corresponding to 330 vibrations per second. The rotating machine causes the siren to emit a sound of three seconds' duration, alternating every ninety seconds with a series of three notes, each of three seconds' duration, with intervals of three seconds between each note. There are two reservoirs for storing the necessary air for starting the apparatus instantaneously; they have each a capacity of 10,660 cubic yards, and are tested at a pressure of 210 pounds.

The Sandettie lightship and accessories will cost 340,000 francs.

The crew will consist of a captain and a mate, who will succeed each other on board every alternate fortnight; twelve seamen, eight of whom will be on board and four on land, so that each seaman will in turn spend a month on board and a fortnight on land; and two mechanics to attend to the engines, who will succeed each other on board in rotation every fifteen days.

Protected Twin-Screw Torpedo Boats Siroco and Mistral.

Messrs. Augustin Normand and Company, of Havre, have recently delivered to the French Government, at Cherbourg, two protected torpedo boats, fitted with the same machinery and boilers as the *Cyclone*. The trials offer special interest on account of the very heavy weights carried. The dimensions are: Length on load line, 147 feet extreme breadth outside armor, 16 feet 10 inches. The nickel steel armor extends to the machinery and boiler compartments, and is distributed as follows: Vertical sides from eight inches below the water line to the deck; fore and aft bulkheads from 16 inches below the water line to the deck; vertical sides of coverings of all parts of machinery and boilers, and of the steering engine above deck 24 millimeters (1 inch bare). All horizontal parts of deck and hatchways, 9 millimeters (11-32 inch full). The total extra weight resulting from the addition of armor, including the strengthening of the hull amidship and the addition of a central hollow keel one foot high, extending to about one-half the length of the boats, and intended to stiffen the central part of the structure and to check rolling, is 24 English tons.

The hulls are very strong, as was proved by an accident which occurred to an exactly similar protected torpedo boat in a trial outside Lorient. When steaming at about 23 knots, during foggy weather, she ran end on against a rock rising above water, and although several men were injured by the shock, no material damage beyond the crushing of about 25 feet of the fore part occurred to the boat, which was towed back to harbor.

The total other weights carried on trial, exclusive of chains, anchors, masts, boats, etc., and comprising only torpedo tubes and compressing pump, artillery and ammunition, provisions, water for boilers and crew, coals necessary for steaming 1,020 nautical miles at 14 knots, crew and effects, provisions, including 5 tons for sundries to complete displacement at sea, amounted to 39.9 English tons in the *Siroco*, and 43.2 tons in the *Mistral*. Accordingly, the displacement on trial was 177.5 English tons for the *Siroco*, and 178.7 for the *Mistral*.

The full speed trial, which took place after the ordinary preliminary runs on the measured mile, were of four hours' duration, one hour of which was to be run at 22 knots, one hour at maximum speed, and the next two hours at 22 knots. The one hour maximum speed was found to be 28.341 for the *Siroco*, and 28.102 knots for the *Mistral*. Only 26 knots were required by the contract. The maximum speed of the *Cyclone* (unprotected), with a displacement of 141 English tons, was 30.7.

SHIP SUBSIDY BILL.

On December 9th Mr. Frye introduced in the Senate of the United States the following bill, which was read twice and referred to the Committee on Commerce:—

Title I.

OCEAN MAIL STEAMSHIPS.

SECTION 1. That section one of an Act approved March third, eighteen hundred and ninety-one, entitled "An Act to provide for ocean mail service between the United States and foreign ports, and to promote commerce," be, and hereby is, amended to read:

The Postmaster-General is hereby authorized and directed to enter into contracts, for a term not less than five nor more than fifteen years in duration, with American citizens for the carrying of mails on American steamships between ports of the United States and such ports in foreign countries, the Dominion of Canada excepted, as in his judgment, having regard to the national defense, will best subserve and promote the postal, commercial, and maritime interests of the United States; the mail service on such lines to be equitably distributed among the Atlantic, Mexican Gulf, and Pacific ports. Said contracts shall be made with the lowest responsible bidder for the performance of said service on each route, and the Postmaster-General shall have the right to reject all bids not in his opinion reasonable for the attaining of the purposes named.

SEC. 2. That section three of the Act aforesaid be, and the same is hereby, amended to read:

SEC. 3. That the vessels employed in the mail service under the provisions of this Act shall be American-built steamships, owned and officered by American citizens, in conformity with the existing laws, or so owned and officered and registered according to law; and upon each departure from the United States the following proportion of the crew shall be citizens of the United States, to wit: During the first two years of such contract for carrying the mails, one-fourth thereof; during the next three succeeding years, one-third thereof, and during the remaining time of the continuance of such contract, at least one-half thereof; and shall be constructed after the latest and most approved types, with all the modern improvements and appliances for ocean steamers. They shall be steel-screw steamships, and divided into the following classes according to gross registered tonnage and capacity to maintain at sea in ordinary weather the following speeds:

Over ten thousand tons:

First class, twenty knots or over.

Second class, nineteen knots and less than twenty knots.

Over five thousand tons:

Third class, eighteen knots or over.

Fourth class, seventeen knots and less than eighteen knots.

Fifth class, sixteen knots and less than seventeen knots.

Sixth class, fifteen knots and less than sixteen knots.

Over two thousand tons:

Seventh class, fourteen knots or over.

It shall be stipulated in the contract or contracts to be entered into for the said mail service that said ves-

sels may carry passengers with their baggage, in addition to said mails, and may do all ordinary business done by steamships.

SEC. 3. That section four of the Act aforesaid be, and hereby is, amended to read as follows:

SEC. 4. That all steamships of the first, second, third, fourth, and fifth classes, employed as above and hereafter built, shall be constructed with particular reference to prompt and economical conversion into auxiliary naval cruisers, and according to plans and specifications to be agreed upon by and between the owners and the Secretary of the Navy; and they shall be of sufficient strength and stability to carry and sustain the working and operation of at least four effective rifled cannon of a caliber of not less than six inches, and shall be of the highest rating known to maritime commerce. And all vessels of said five classes heretofore built and so employed shall, before they are accepted for the mail service herein provided for, be thoroughly inspected by a competent naval officer or constructor detailed for that service by the Secretary of the Navy; and such officers shall report, in writing, to the Secretary of the Navy, who shall transmit said report to the Postmaster-General; and no such vessel not approved by the Secretary of the Navy as suitable for the service required shall be employed by the Postmaster-General as provided for in this Act.

SEC. 4. That section five of the aforesaid Act be, and is hereby, amended to read:

SEC. 5. The rate of compensation for such ocean mail service, to be paid per gross registered ton for each one hundred nautical miles sailed from the port of clearance in the United States to the port of entry in the United States, according to the route required by the Postoffice Department, shall not exceed the following:

Steamships of the first class, two and seven-tenths cents.

Steamships of the second class, two and five-tenths cents.

Steamships of the third class, two and three-tenths cents.

Steamships of the fourth class, two and one-tenth cents.

Steamships of the fifth class, one and nine-tenths cents.

Steamships of the sixth class, one and seven-tenths cents.

Steamships of the seventh class, one and five-tenths cents.

The rates of compensation to a steamship to be employed in carrying the mails to a foreign port in North America under any contract hereafter to be made under the provisions of this Act shall not exceed seventy per centum of the maximum rates established by this section: *Provided*, That in the case of failure from any cause to perform the regular voyages stipulated for in said contracts, or any of them, a pro rata deduction shall be made from the compensation on account of such omitted voyage or voyages, and that suitable fines and penalties may be imposed for delays or irregularities in the due performance of service according to the contract, to be determined by the Postmaster-General: *Provided further*, That no steamships so employed and so paid for carrying the United States mails shall receive any other bounty or subsidy from the Treasury of the United States.

SEC. 5. That section eight of the Act aforesaid be, and the same is hereby, amended to read:

SEC. 8. Such vessels shall take, as cadets or apprentices, one American-born boy, under twenty-one years of age for each one thousand tons gross register, and one for each majority fraction thereof, who shall be educated in the duties of seamanship, or engineering rank as petty officers, and receive such pay for their services as may be reasonable.

Title II.

GENERAL SUBSIDY.

SEC. 6. That from and after the first day of July, nineteen hundred and two, the Secretary of the Treasury is hereby authorized and directed to pay, subject to the provisions of this title, out of any money in the Treasury not otherwise appropriated, to the owner or owners of any vessel of the United States duly registered by a citizen or citizens of the United States (including as such citizens any corporation created under the laws of the United States or any of the States thereof), and being at the time of entry engaged in the foreign trade of the United States, which shall be entered in the United States from a foreign port or from any port in the Philippine Islands, compensation as hereinafter provided, that is to say:

(a) On each entry, not exceeding sixteen entries in any one fiscal year, of a sail or steam vessel, one cent per gross registered ton for each one hundred nautical miles sailed.

(b) On each entry, not exceeding sixteen entries in any one fiscal year, and for a period of five years from the date of registration of a vessel of over one thousand five hundred gross registered tons, which shall be completed and registered after the passage of this Act, one-fourth of one cent per gross registered ton for each one hundred nautical miles sailed, in addition to the compensation provided in paragraph (a).

SEC. 7. That compensation under this title shall not be allowed in respect of any of the following-named vessels:

(a) A vessel on a voyage extending only to a foreign port less than one hundred and fifty nautical miles from her last port of departure in the United States or from a foreign port less than one hundred and fifty nautical miles from her first port of arrival in the United States.

(b) A vessel on a voyage less than one-half of the whole length of which, on her outward and homeward voyages, respectively, shall have been on the sea between a port of the United States and a foreign port.

(c) A vessel which shall not be at least of the Class A1, as classified either by the Record of American and Foreign Shipping or the United States Standard Owners, Builders, and Underwriters' Association, or equivalent classification in any other register of shipping of at least equal merit.

(d) A vessel of which less than one-fourth of the crew shall be citizens of the United States or such persons as shall be within the provisions of section twenty-one hundred and seventy-four of Revised Statutes.

(e) A barge, canal boat, or vessel without motive power of its own, or a tugboat, or a vessel engaged in wrecking.

(f) A foreign-built vessel, hereafter admitted to American registry pursuant to the provisions of section forty-one hundred and thirty-six of the Revised Statutes.

(g) A vessel while employed in the coasting trade.

SEC. 8. That the mileage upon which compensation shall be paid under this title shall be determined by the direct customary route from the last port of departure in the United States to a foreign port or a port in the Philippine Islands, and from such last-mentioned port by the direct customary route to the first port of arrival in the United States. If during the voyage the vessel shall enter at two or more foreign ports or ports in the Philippine Islands, the distance by the direct customary route between such ports shall also be included in the mileage upon which compensation shall be paid under this title.

SEC. 9. That any vessel, before receiving compensation under this title, shall have carried, free of charge, the mails of the United States, if the Postmaster-General shall have so required, for the whole or any part of a voyage for which compensation shall be claimed.

SEC. 10. That any vessel, before receiving compensation under this title, shall, when required so to do by the Secretary of the Treasury, carry on each foreign voyage, as a member of the ship's company, one American boy, under twenty-one years of age and suitable for such employment, and one such boy in addition for each one thousand gross registered tons, who shall be taught in the duties of seamanship or engineering, or other maritime knowledge, as the case may be, respectively, and receive such pay as shall be reasonable.

SEC. 11. That the owner of any vessel, before receiving compensation pursuant to this title, shall agree, in writing, that said vessel may be taken or employed and used by the United States for the national defense or for any public purpose at any time; and in every such case the owner of any such vessel so taken or employed shall be paid the fair value thereof, if taken, at the time of the taking; and if employed, shall be paid the fair value of such use. And if there shall be a disagreement as to such fair value the question of the valuation shall be submitted to and determined by three impartial appraisers, one to be appointed by the Secretary of the Treasury, one by the owner or owners of the vessel, and the two appraisers so appointed shall, before they proceed to act, select a third appraiser. The decision of a majority of such board shall be final and effective. In case of any taking or employment, as provided in this section, the shipping obligations of the officers and crews existing at the time shall be deemed to have terminated.

Title III.

DEEP-SEA FISHERIES.

SEC. 12. That from and after the first day of July, nineteen hundred and two, the Secretary of the Treasury is hereby authorized and directed to pay, out of any money in the Treasury not otherwise appropriated, bounties as follows:

(a) To the owner or owners of a documented vessel of the United States engaged in the deep-sea fisheries for at least three months in any one fiscal year, two dollars per gross ton per annum: *Provided*, That at least one-third of the crew shall be citizens of the United States, or such persons as shall be within the provisions of section twenty-one hundred and seventy-four of the Revised Statutes.

(b) To a citizen of the United States serving as a member of a necessary and proper crew of a vessel of the United States documented and engaged in deep-sea fisheries for at least three months during any one fiscal year, one dollar per month during the time necessarily employed in the voyages of such vessel.

Title IV.

GENERAL PROVISIONS.

SEC. 13. That a vessel shal not be entitled to compensation under two or more titles of this Act at the same time.

SEC. 14. That a vessel which has at any time received compensation pursuant to any of the provisions of this Act shall not be sold, except by the consent of the Secretary of the Treasury, to a citizen or subject of a foreign power, under penalty of forfeiture.

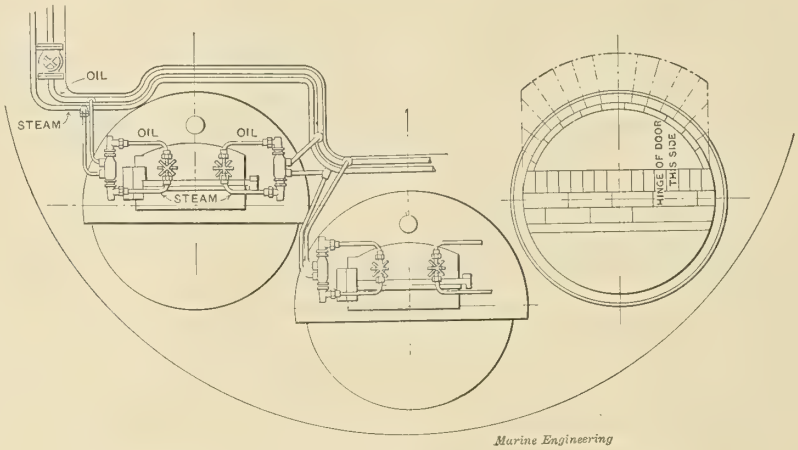
SEC. 15. That the President of the United States shall from time to time cause to be made, by the proper heads of departments, regulations for the due execution of the provisions of this Act.

Liquid Fuel at Sea.

The use of oil fuel on steamers is being introduced to a considerable extent in Great Britain, the Flannery-Boyd patent system being generally employed. One of the greatest obstacles to be overcome in fitting old steamers with oil burning appliances is making suitable oil tight tanks. Coal bunkers are too light, and the riveting is not oil tight, while the ballast tanks at the ends and in the double bottom would not do because of the water that might leak in. With former systems means have not been used to separate the oil from the water, and a small percentage of water in the fuel causes the flame at the burners to sputter and go out, frequently resulting in an explosion upon relighting. In this system water separation is accomplished in the following manner. Two liquid fuel settling tanks of large capacity and with special arrangements are placed in the 'tween decks amidships immediately adjacent to the boiler room bulkhead. These tanks are fitted with all the necessary heating coils, draining arrangements, thermometers, glass indicators, and other fittings, to enable the liquid fuel to be heated to a sufficient temperature to allow the water being freely separated. Any water which may settle in the bottom of the tanks can at once be drained off. Each tank is made of sufficient size to contain half a day's supply of liquid fuel, so that while the liquid fuel is being used to supply the burners from one tank, the water is being separated in the other. The settling tanks can be filled either direct from the deck or the forward liquid fuel carrying spaces by means of a pump placed in the forward end of the vessel, or from the after ballast tanks or cofferdam, by means of two special pumps placed in the stokehold. The liquid

fuel gravitates from the settling tanks through suitable filtering arrangements, which form an important point in the system, direct to the burners, and is there injected into the furnaces with a spray of steam. Each furnace is fitted with two burners. The furnace arrangements are such that the complete coal-burning gear remains intact, so that either coal or liquid fuel all boilers. Particular note is to be made of the special feature of the installation whereby coal or oil can be burnt at will, so that an owner may at any part of the world, direct his steamer to use either liquid fuel or coal, whichever he might find most economical.

The Wallsend Shipway and Engineering Company, who have fitted no less than fifty vessels with oil burn-

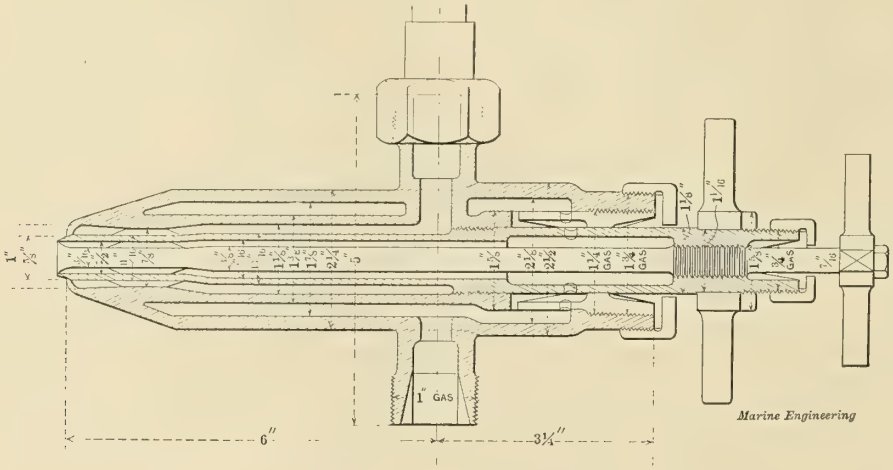


OIL BURNERS APPLIED TO THE FURNACES OF A SCOTCH BOILER.

may be resorted to at will. If the vessel is burning liquid fuel, and it is found necessary from economical reasons to resort to coal burning, then it is only necessary to rake some broken fire bricks from off the fire bars, disconnect the burners and light a coal fire. In actual experience this operation can be carried out on a large vessel in less than an hour and without shutting down.

ing apparatus, are now equipping eight more with the system installed on the *Trocas*.

This vessel went on trial recently, and for a number of hours used oil fuel. Afterwards, in order to illustrate how easily the transformation could be made in the arrangements, a change was made to coal without stopping the machinery, the order to discontinue



DETAIL OF OIL BURNER.

The tank steamer *Trocas* has recently been equipped with this system of oil burners, and as the fuel has a flash point of 200 degrees it is carried in the ballast tanks throughout the ship without conflicting with the requirements of the underwriters or with Lloyds. The *Trocas* is of 4,129 gross tons and is powered by a triple expansion engine and three single-ended boilers, each with three furnaces, and one multitubular auxiliary boiler with two furnaces. Liquid fuel is used with the oil fuel and to adopt coal being carried out in half an hour's time.

The departure from the ordinary system in this case was that two burners were used, the ordinary fire bars being also employed, which, on using oil fuel, were covered with broken fire bricks. These, when oil is used, become incandescent and assist very much in the perfect combustion of the fuel. The above facts are taken from *The Engineer*.

Torpedo Boat Goldsborough.

The torpedo boat *Goldsborough*, which was contracted for on July 30, 1897, was completed on December 30, 1898, and since that date numerous attempts have been made to make contract speed on official trials, these, to the present date, have resulted in breakdowns, causing delays. The vessel was overhauled at the navy yard, Puget Sound, Washington, and an unofficial preliminary trial trip was made on November 13th over the prescribed course, on which a speed of slightly over 30 knots was several times attained, the propellers making 340 revolutions per minute. However, one of the blower engines failed to work properly, and this speed could not be maintained. The photograph showing her in normal condition was taken before she started on her trip. Two days later the *Goldsborough* was taken out on the trial which ended

TORPEDO BOAT GOLDSBOROUGH.

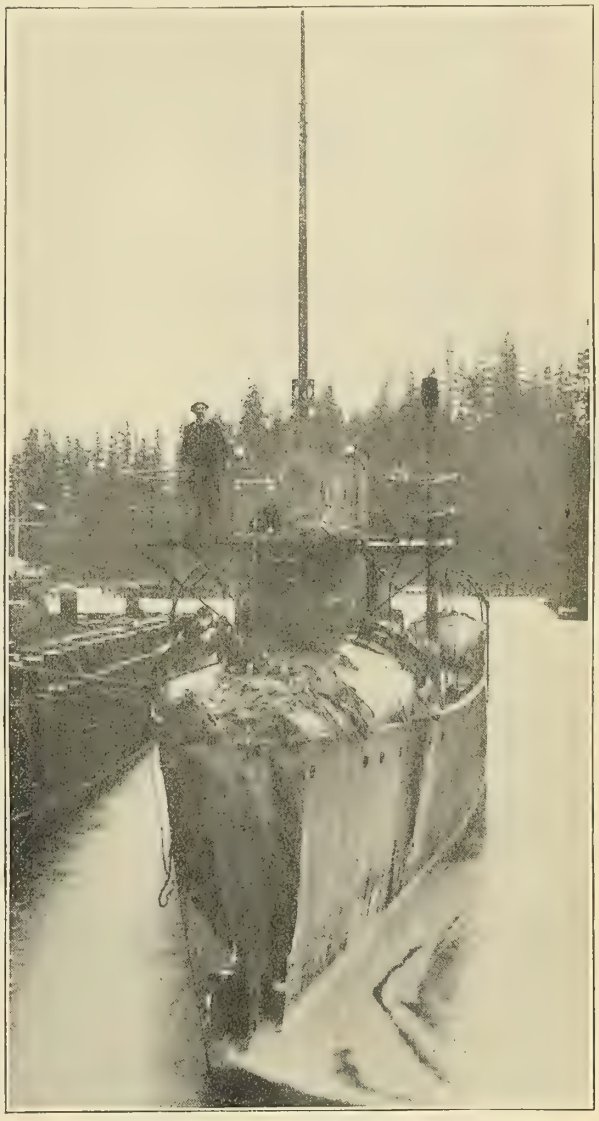
so disastrously. She averaged about 28 knots, the engines not making more than 300 revolutions. It is given out that she failed to make a better speed because of poor quality of coal—a sufficient head of steam could not be obtained. On returning to the yard the boat was steered to make a swide sweep past the regular wharf, and while on this turn she ran head-on into the ordnance wharf, snapping several of the heavy piles like match wood, and crushing in her bows, as shown in the engraving. It was reported that the engine room signals were misunderstood or failed to act.

Robert Fulton Memorial.

On December 5th the American Society of Mechanical Engineers honored the memory of Robert Fulton by unveiling a suitable memorial to this great man over his tomb in Trinity Churchyard, of New York City.

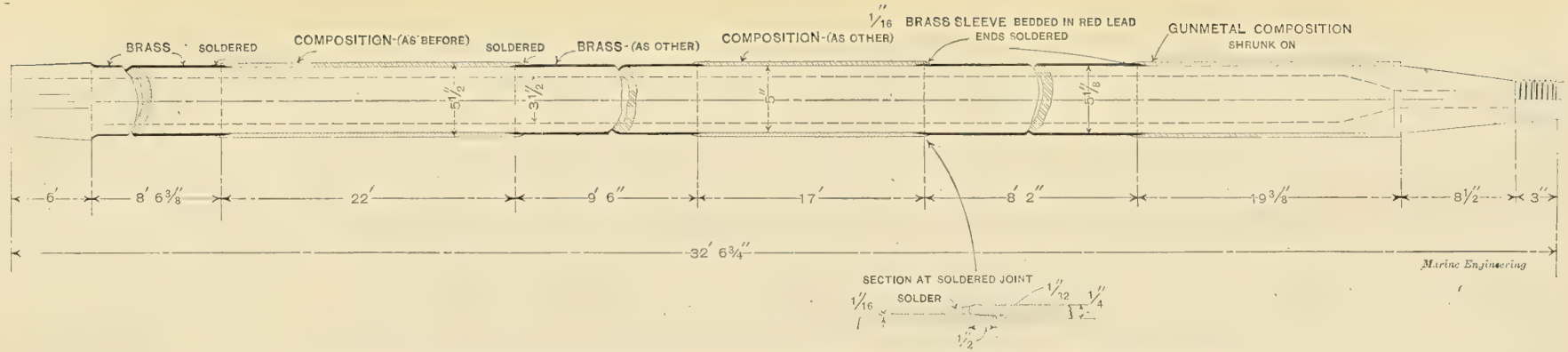
For nearly eighty-seven years the resting place of Robert Fulton has been but barely marked, and yet the engineers of this generation, realizing the important work that Robert Fulton did for civilization, deemed it fit to honor in this wise the great engineer.

Robert Fulton was born in the township of Little Britain, in Lancastershire County, Pa., in 1755, and his early days were spent in studying art and painting, both on this side and in England. His natural tendencies, however, carried him finally into engineering, and in 1793 he published a treatise on canal navigation, and a year later took out a British patent for a double inclined plane for raising and lowering boats from one level to another in a system of canals which he had planned. He also received other patents for mechanical inventions, designed and built an aqueduct and viaduct in England, and as a result of the naval war between England and France of 1797 made elaborate experiments in submarine explosion by means of a torpedo. He also designed a closed boat to navigate beneath



THE GOLDSBOROUGH AFTER COLLISION.

the surface of the water, called the *Nautilus*, which was probably the first submarine boat ever built. A committee appointed by Bonaparte to investigate this invention reported favorably, and the sum of 10,000 francs was granted to conduct further experiments. With this boat Fulton was able to navigate on the surface, and to submerge the boat for thirty minutes at a time. Mechanical propulsion was secured by turning a crank actuating a wheel with elliptical buckets situated at the stern. He made several trips with this boat to demonstrate the feasibility of submarine navigation.



METHOD OF LINING PROPELLER SHAFTS WITH BRASS TUBING AND COMPOSITION TO PREVENT CORROSION.

In 1806, Fulton returned to this country and solicited the aid of Congress. He now devoted his attention to the marine engine, and through the assistance of Robert H. Livingston, the United States Minister to France, bought an engine from Bolton and Watt of Birmingham, England. The world-famed *Clermont* was built in the spring of 1807, and in August of that year this little boat successfully ascended the Hudson River. A grant was obtained from the State of New York, giving Livingston and Fulton the exclusive right of navigating with steam vessels the waters of the State, and they were allowed two years to produce a steamboat of not less than 20 tons burden that should move with or against the tides of the Hudson River at the rate of four miles an hour. The boat was 130 feet long, 16 1-2 feet beam and 4 feet deep. The engine had a steam cylinder 24 inches in diameter by 48 inches stroke; the paddle wheels were 15 feet in diameter. The boiler was 20 feet long, 7 feet high and 8 feet wide. This trip of the *Clermont* demonstrated that it was thoroughly practical to use steam power for propelling vessels. He later designed and built several steam vessels, including a ferry boat and a large war vessel called the *Fulton the First*, which was protected by several of his inventions.

It is not claimed for Fulton that he invented the steamship, but that he gathered together the best engineering material of his day and designed an engine, boiler and vessel on thoroughly practical lines which would meet the requirements of the new service. It is for his mechanical ability and to the service rendered mankind by the demonstration made by his steamboat that the engineers of this day have honored him.

METHOD OF LINING PROPELLER SHAFTS.

A method for lining propeller shafts to prevent corrosion has been used by Mr. Charles D. Mosher with much success on the several small high-speed yachts which he has designed. This system of protecting the propeller shafts has given satisfaction, and the simplicity of construction and application will doubtless recommend it to those familiar with the subject.

The latest shafts which have been so fitted are those on the twin-screw steam yacht *Arrow*, owned by Mr. Charles R. Flint, and described in MARINE ENGINEERING of November, 1900. The shaft, as will be seen by referring to the drawing, is 32 feet 6 3-4 inches long, 5 inches in diameter, with a hole bored throughout its length of 3 1-2 inches diameter, except at the tapered end, where it is reduced to 1 1-2 inches. The shaft is a nickel steel forging furnished by the Bethlehem Steel Company.

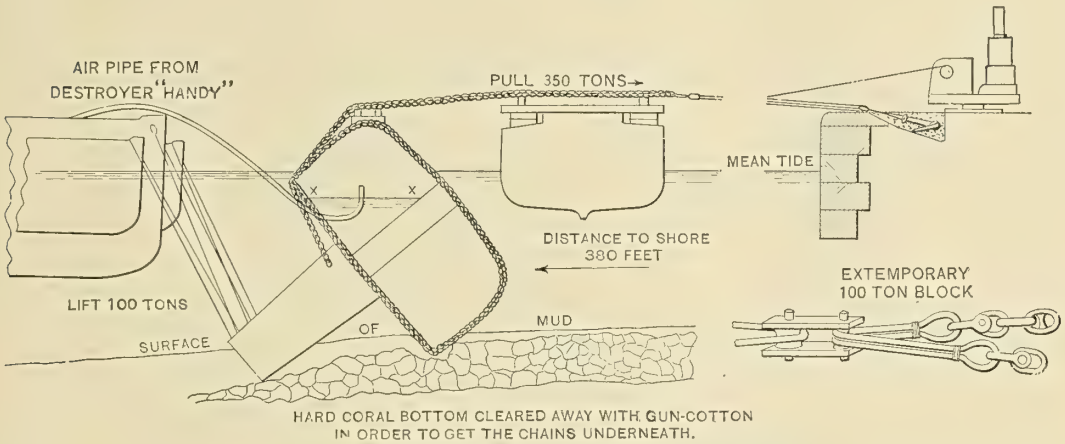
The liner is made up of alternate sleeves of brass tubing of 1-16 inch in thickness, and sleeves of composition 1-4 inch in thickness located on the shaft to agree with the positions of the bearings. As the brass sleeve only serves to protect the shaft from corrosion, it can be made of the lightest metal. The greatest length of any one piece is 9 feet 6 inches. The operation for shrinking on this sleeve was of the simplest character. As will be seen, the shaft should first be placed on V blocks, one end of the shaft being considerably lower than the other, so as to enable water poured in at one end to flow out through the other end of the shaft. The apparatus for carrying out the work consists of a piece of gas pipe (about equal in length to the sleeve to be shrunk on) with a row of holes, perhaps 1-16 inch in diameter, drilled about 5 inches apart. The piece of gas pipe is connected by rubber tubing of convenient length for supplying the gas. It is also preferable to have a supply of air under pressure mixed with the gas for a more intense heat. By igniting the jets throughout the length of this pipe the sleeve may be heated to the desired temperature. It will be seen that this apparatus is very portable and simply constructed. The sleeve can be evenly heated by revolving it over the burner so that it will slip on freely over the shaft, and may be forced into final position by a pair of blocks and tackle secured to a collar placed back of the sleeve, the other end of the tackle being made fast to the opposite end of the shaft.

In practice it has been found that a heat of about 500 to 600 degrees will produce satisfactory results, and this temperature may be measured by placing on the sleeve

small pieces of tin, which will fuse at this temperature. It will be seen that the gas pipe may be carried along the sleeve and thereby prevent the latter from cooling and becoming stuck before reaching the final position, while the shaft may be kept cool by pouring water through the hole, as has been previously stated. The difference in size between that of the shaft and the internal diameter of the sleeve may be arrived at by referring to the tables giving the coefficients of expansion due to the dissimilar metals. As shown in the small detail, the composition sleeves are counterbored to a depth of 1-2 inch, to slide on over the tapered ends of the thinner sleeves, while the joint is further made water tight by solder. It is suggested that in order to insure the proper difference of size between the sleeve and the shaft that a small piece of tube a few inches long be first tried, as it will be found that the expansion of the compositions will vary greatly from that given in the usual text books.

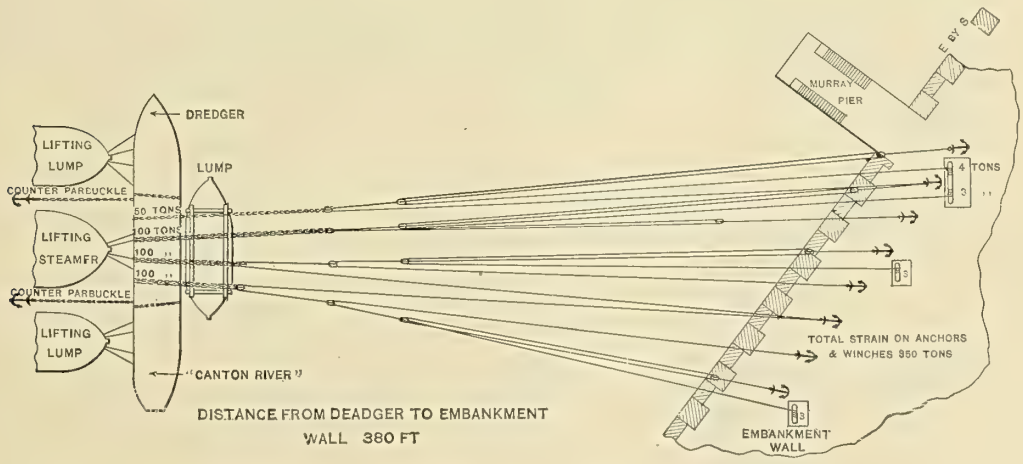
Turning and Raising a Sunken Dredge.

An account is given in *Marine Engineer* of an interesting salvage feat carried out at Hong Kong. During a typhoon a year ago the dredge *Canton River*, belonging to the Admiralty Docks, foundered and turned bottom up not far from a sea wall. In order to raise the dredge it was first necessary to right her, but several attempts proved unsuccessful. Captain Percy Scott, of H. M. S. *Terrible*, then undertook to turn the dredge in the manner illustrated in the accompanying cuts.



DETAILS OF RIGGING FOR RAISING AND TURNING A DREDGE.

Four chains were passed completely around the vessel and secured to the upper deck. The chains were of 1 5-8 inch cable and three of them were double. The other ends were passed over a cradle placed on the bilge, to a barge where the purchases were attached to four parbuckles capable of sustaining a total load of 350 tons. The parbuckles were of wire, and to each was made fast a fivefold Manila purchase.



ARRANGEMENT FOR RAISING AND TURNING A DREDGE.

The leads were taken ashore, one end to a steam windlass, the other to an anchor. In all, eight anchors were used distributing the load over a distance of 100 feet along the sea wall. A strong connection between the parbuckles and purchases was made out of the dredge's spare links as shown in the illustration on page 27.

To prevent the vessel from being hauled toward the shore instead of turning, counter parbuckles were laid and three boats on the opposite side were used as a lift by lashing them to the dredge at low water while they were loaded.

When all was in readiness air was forced into the hull of the dredge until the water had receded to the level XX, and the winches started up, care being taken to produce a uniform pull. The vessel was righted on the bottom without trouble, the upper deck then being in nine feet of water. A cofferdam was built over the hatches, the leaks in the hull stopped and four pumps were soon discharging the water from the hull. She was then pulled along the bottom into shallower water, but a bad leak developed on the port side which admitted more water than the pumps could handle. As there is a longitudinal bulkhead in the vessel, the buoyancy of the two sides was unequal, and she took a decided list, which, with the heavy top weight, caused her to capsize again.

The previous plan of righting was resorted to, though owing to her position the anchors had to be placed on the bottom and the purchases led to another ship. The H. M. S. *Centurion* was anchored for this purpose and a barge with steam windlasses moored to her stern. This time nine anchors and three purchases were used and two of the leads taken to the *Centurion's* capstans, and one to the barge. Again the barge was hauled upright, and six months after the first righting was successfully floated.

RED D LINE STEAMER ZULIA.

One of the latest additions to our coasting and West Indian fleet is found in the steamer *Zulia* belonging to the Red D Line and built by the Neafie and Levy Ship and Engine Building Company.

The principal dimensions of hull are:

Length over all	277 ft. 6 in.
Length, perpendiculars	266 " 0 "
Beam, molded	37 " 0 "
Depth, "	18 " 6 1/16 "
Depth, at center	19 " 3 3/4 "
Load draft	10 " 6 "
Corresponding displacement	2,144 tons.
Gross tonnage	1,713 "
Net "	1,079 "
Block coefficient	.71
Tons per inch	18.

The outward appearance of the ship as shown in the engraving on this page is very pleasing. She is of the two deck type with poop and forecastle and a two deck bridge house, and is classed under the Record of American and Foreign Shipping. The two steel pole masts are fitted with leg of mutton sails and for handling cargo the foremast has three derricks and the mainmast two. The flat plate keel is 30 inches by 22 1-2 pounds amidship; the frames are 4 by 3 inches by 7 1-2 pound angles spaced 24 inches, and are carried up at the ends to the poop and forecastle gunwale; the reverse frames are 3 by 2 1-2 inches by 5 1-2 pounds; the stern post is of cast steel, and the rudder is of the cast steel plate type bolted to a wrought iron stock.

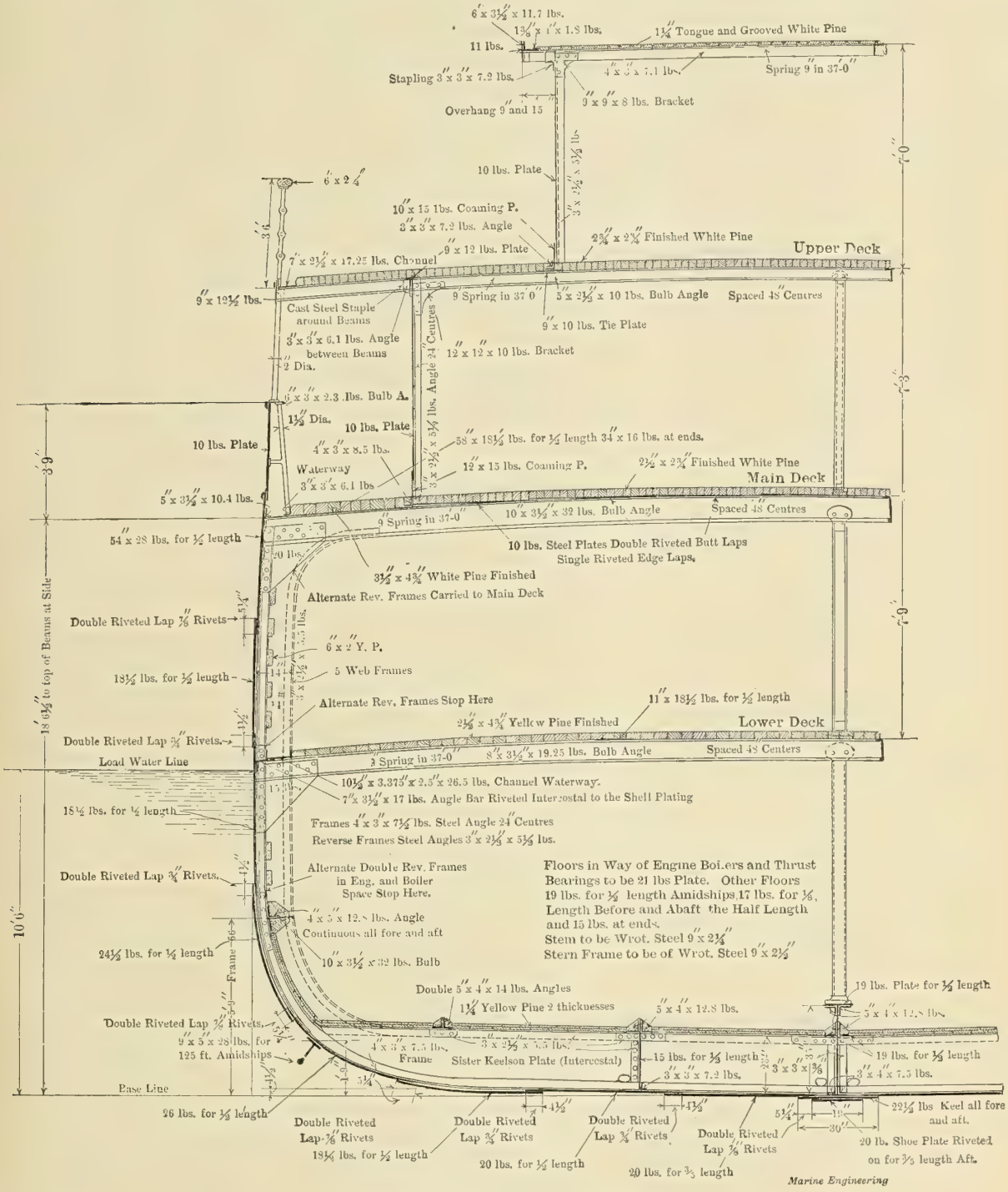
STEAMER ZULIA, FOR THE NEW YORK AND WEST INDIAN SERVICE.

Besides the forward and after collision bulkheads there are four water tight bulkheads extending to the main deck, and there is one aft the engine room up to the lower deck to form a deep tank for use when the ship is in ballast. The main deck is of steel from end to end, planked with white pine, and the lower and upper decks are laid with white and yellow pine respectively. The hold is ceiled with two thicknesses of yellow pine. The details of construction are given in

the cuts of the midship section on page 29, and the inboard profile on page 30.

The forecastle, which is 48 feet long, contains the crew's quarters, a large steward's storeroom, and a

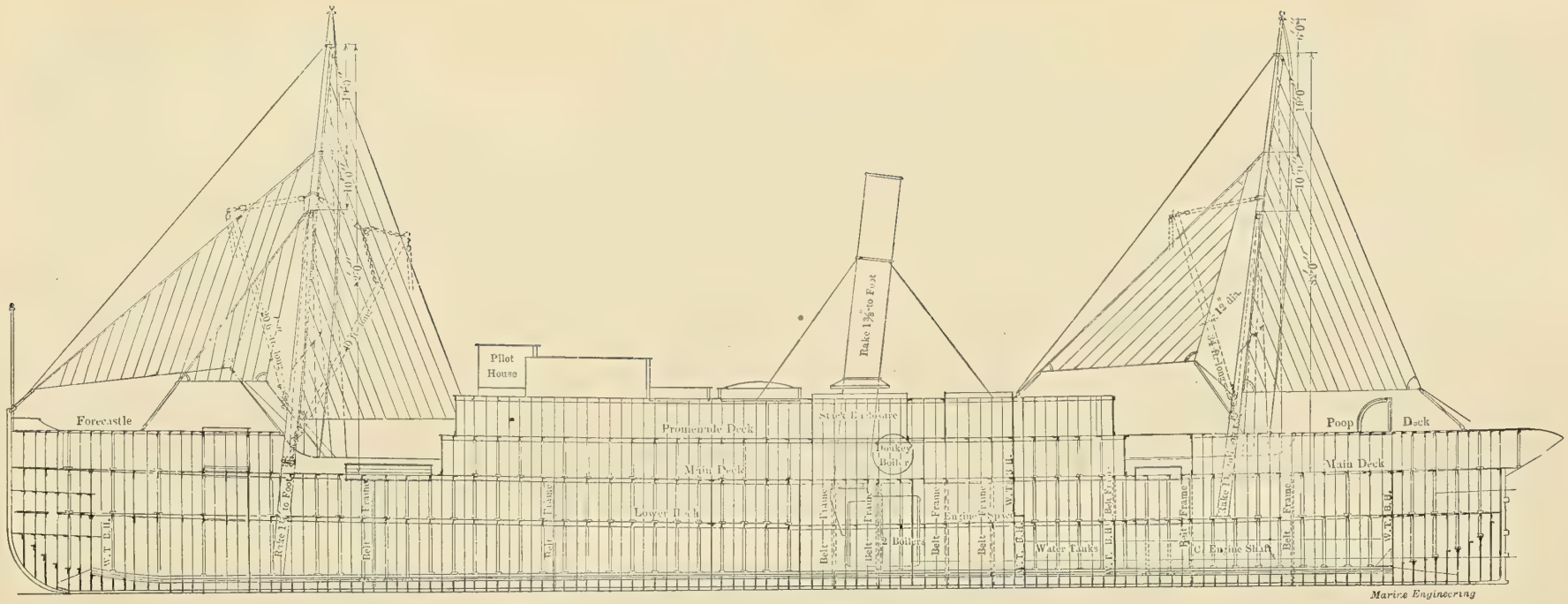
Accommodations for 48 first class passengers are provided in the deck house. The dining saloon and six staterooms are at the forward end, then comes the pantry and galley, storerooms, rooms for stewards,


6" x 3½" x 11.7 lbs.
1⅝" x 1" x 1.8 lbs.
11 lbs.
1¼" Tongue and Grooved White Pine
Stapling 3" x 3" x 7.2 lbs.
4" x 3" x 7.1 lbs.
Spring 9" in 37-0"
Overhang 9" and 15
9" 9" x 8 lbs. Bracket
10 lbs. Plate
6" x 2 4"
10" x 15 lbs. Coaming P.
3" x 3" x 7.2 lbs. Angle
9" x 12 lbs. Plate
2¾" x 2¼" Finished White Pine
Upper Deck
7" x 2½" x 17.25 lbs. Channel
9" x 12½ lbs.
Cast Steel Staple around Beams
3" x 3" x 6.1 lbs. Angle between Beams
2 Dia.
9 Spring in 37 0"
5" x 2½" x 10 lbs. Bulb Angle
Spaced 48 Centres
9" x 10 lbs. Tie Plate
12" x 12" x 10 lbs. Bracket
6" x 3" x 2.3 lbs. Bulb A.
1½" Dia.
10 lbs. Plate
58" x 18½ lbs. for ½ length 34" x 16 lbs. at ends.
4" x 3" x 8.5 lbs.
Waterway 3" x 3" x 6.1 lbs
12" x 15 lbs. Coaming P.
2½" x 2¾" Finished White Pine
Main Deck
5" x 3½" x 10.4 lbs.
10" x 3½" x 32 lbs. Bulb Angle
Spaced 48 Centres
9" Spring in 37-0"
54" x 28 lbs. for ½ length
10 lbs. Steel Plates Double Riveted Butt Laps
Single Riveted Edge Laps.
3½" x 4¾" White Pine Finished
Alternate Rev. Frames Carried to Main Deck
Double Riveted Lap ⅞" Rivets
6" x 2" Y. P.
18½ lbs. for ½ length
5 Web Frames
Alternate Rev. Frames Stop Here
11" x 18½ lbs. for ½ length
2½" x 4¾" Yellow Pine Finished
Lower Deck
Double Riveted Lap ¾" Rivets.
Load Water Line
8" x 3½" x 19.25 lbs. Bulb Angle
Spaced 48 Centers
10½" x 3.375" x 2.5" x 26.5 lbs. Channel Waterway.
7" x 3½" x 17 lbs. Angle Bar Riveted Intercostal to the Shell Plating
18½ lbs. for ½ length
Frames 4" x 3" x 7½ lbs. Steel Angle 24" Centres
Reverse Frames Steel Angles 3" x 2½" x 5½ lbs.
Double Riveted Lap ¾" Rivets.
Alternate Double Rev. Frames in Eng. and Boiler Space Stop Here.
Floors in Way of Engine Boilers and Thrust Bearings to be 21 lbs Plate. Other Floors 19 lbs. for ½ length Amidships 17 lbs. for ½ Length Before and Abaft the Half Length and 15 lbs. at ends.
Stem to be Wrot. Steel 9" x 2¼"
Stern Frame to be of Wrot. Steel 9" x 2½"
4" x 3" x 12.8 lbs. Angle
Continuous all fore and aft
24½ lbs. for ½ length
10" x 3½" x 32 lbs. Bulb
Double 5" x 4" x 14 lbs. Angles
1¼" Yellow Pine 2 thicknesses
19 lbs. Plate for ½ length
5" x 4" x 12.8 lbs.
Double Riveted Lap ⅞" Rivets.
9" x 5" x 28 lbs. for 125 ft. Amidships
4" x 3" x 7.5 lbs. Frame
Sister Keelson Plate (Intercostal)
15 lbs. for ½ length
19 lbs. for ½ length
3" x 3" x 7.2 lbs.
3" x 4" x 7.5 lbs.
Base Line
26 lbs. for ½ length
Double Riveted Lap ⅞" Rivets
18½ lbs. for ½ length
Double Riveted Lap ¾" Rivets
20 lbs. for ½ length
Double Riveted Lap ¾" Rivets
20 lbs. for ⅗ length
Double Riveted Lap ⅞" Rivets
22½ lbs Keel all fore and aft.
20 lb. Shoe Plate Riveted on for ⅗ length Aft.
Marine Engineering

MIDSHIP SECTION OF STEAMER ZULIA.

hatch 8 by 8 feet, opening into the forward hold. The main cargo hatch is 15 by 20 feet forward of the deck house. Two winches are at the foremast and located on the main deck and two are at the mainmast on the poop.

engineers and purser, and a large officers' dining room is at the after end. On the promenade deck, which extends from side to side of the ship, are 16 staterooms, a social hall, lavatories and smoking room. The chart house and officers' quarters are on the hurri-



LONGITUDINAL ELEVATION OF THE STEAMER ZULIA.

cane deck where also the boats are carried.

Thirty-two passengers can be carried in the second cabin, which is built in a house under the poop deck. There are eight large rooms and commodious lavatories. Two refrigerators are at the after end of the poop.

The propelling power of the ship consists of two sets of three cylinder, triple expansion, inverted, direct acting engines. The cylinders are 14, 21 and 36 inches in diameter by 26 inches stroke. Stephenson link motion operates the valves, two of which are slide valves and the third, the high pressure, is of the balanced piston type. The bedplate and rear columns are of cast iron, while steel columns support the cylinders at the front. A condenser, common to both engines, with cast iron shell is located at the after end of the engine room above the thrust bearings. It is fitted with 3-4-inch tubes, giving a cooling surface of 2,200 square feet. The main pumps are as follows. One vertical air pump, 7 1-2 by 15 by 10 inches; one main feed pump, vertical, 6 by 4 by 7 inches, a horizontal 5 1-2 by 5 by 6 inch bilge pump, and a centrifugal circulating pump with a runner 28 inches in diameter. The first three named pumps are of the Blake pattern. A feed water heater made by the shipbuilders is fitted.

The rear ends of the two Scotch boilers project through the forward engine room bulkhead. Each boiler is of the following dimensions:

Length	12 ft. 8 in.
Diameter	12 " 3 "
Number of furnaces	3
Diameter of furnaces	3 " 9 "
Length of grate	6 " 6 "
Number of tubes	206
Size of tubes	3 "
Heating surface	1,840 sq. ft.
Grate surface	63 " "
Height of funnel above grates	67 ft.
Steam pressure	160 lbs.

There is also a cylindrical donkey boiler 9 feet long by 7 feet in diameter. Coal is carried in wing and thwartship bunkers with a capacity of 322 tons.

The propellers are of cast iron, 9 feet diameter and 11 feet 6 inches pitch, with four blades. The propeller shafts are 7 1-2 inches diameter and the line and thrust shafting 7 1-4 inches.

At the load draft of 10 feet 6 inches the *Zulia* can make 12 knots, and at this speed the engines are turning 140 revolutions a minute and developing about 1,200 indicated horse power.

NAME—Zulia. NATIONALITY—American. TYPE—Coaster.

LAUNCHED—1901. BUILDER—Neafie & Levy S. & E. Bldg. Co.

Length between perps.	266 ft. 0 in.	Designed R. P. M.	140
Length over all	277 " 6 "	" I. H. P.	1,200
Beam molded	37 " 0 "	" Speed	12 knots.
Depth to main dk. molded	18 ft. 6 1-2 in.	Condens. surf.	2,200
Draft, loaded	10 ft. 6 in.	**Boilers,** number	2
Displacement	2,144 tons	Type	S. E. Scotch.
Dead wt. capacity	1,713 net tons.	Pressure	160 lbs.
Block coef.	.71	Length	12 ft. 8 in.
Bunker capacity	332 tons.	Diam.	12 " 3 "
Propellers, No. blades	4	Furnaces in each	3
Diam.	9 ft.	Diam. furnaces	39 in.
Pitch	11 ft. 6 in.	G. S. total	126 sq. ft.
Material	Cast iron.	H. S. "	3,680 " "
Engines, number of	2	Draft	Natural.
Type	3 cyl. triple.	H. S. + G. S.	29.2
Cylinder diam.	14, 21, 36	H. S. + I. H. P.	3.07
Stroke	26	I. H. P. ÷ G. S.	9.52

LAUNCHES.

Schooner Kenwood.—The four masted schooner *Kenwood* was launched from the yard of William McKie, of East Boston, on November 27th. She is of 900 gross tons, 184 feet 6 inches long, 37 feet 4 inches beam and 18 feet 4 inches deep. She is built largely of white oak and live oak, and the ceiling and planking are of Georgia yellow pine in extra long lengths. The lower deck is of yellow pine; the upper deck is of white pine.

Steamer Eastern States.—On December 8th the steamer *Eastern States*, of the Cleveland and Buffalo Transport Company, was launched from the Wyandotte yards. The dimensions of the steamer are: 386 feet length over all, 365 feet on the water line; breadth of hull, 45 feet; breadth over guards, 80 feet; molded depth, 20 feet; draught, 12 feet; coresponding displacement, 3,400 tons. This ship is designed for fast night-passenger service between Detroit and Buffalo. The vessel will be driven by a horizontal triple expansion engine of 5,000 horse-power actuating feathering paddle wheels 25 feet in diameter. Scotch boilers will be equipped with the Howden system of forced draft.

Steamer Frank W. Osborne.—On November 16th there was launched from the Lorain yard of the American Shipbuilding Company the steamer *Frank W. Osborne.*

Schooner Mary Barrett.—The schooner *Mary Barrett* was recently launched from the yard of Gardner G. Deering, Bath, Maine, and is of the following dimensions: Length, 241 feet 5 inches; beam, 43 feet 4 inches; depth, 27 feet 8 inches.

Schooner Miles M. Merry.—The four masted schooner *Miles M. Merry* was recently launched from the yard of Percy and Small, Bath, Maine. The dimensions are: Length, 205 feet 3 inches; beam, 43 feet 2 inches, and depth, 20 feet.

Steamship Merion.—The new twin screw steame *Merion*, built for the International Navigation Company, was recently launched from the Clydebank yard of John Brown and Company, Scotland. She is a sister ship to the *Haverford*, described and illustrated in MARINE ENGINEERING of July, 1901.

Passenger-Propeller Calvert.—The Neafic and Levy Ship and Engine Building Company, of Philadelphia, Pa., launched from their yard on November 23d the passenger propeller *Calvert* belonging to the Weems Line. The vessel is 190 feet long, 40 feet beam, 12 feet deep, is driven by compound engines 20 and 40 inches by 28 inches, supplied with steam by Scotch boilers 14 feet 9 inches in diameter, and 12 feet long.

Towboat Vesta.—The first steel hull vessel built by James Rees and Sons' Co., Pittsburg, Pa., was launched from their yard on December 5th. The vessel is a towboat built for the Vesta Coal Company for towing coal barges on the Ohio. The length of this steamer, which is christened the *Vesta*, is 135 feet, the beam is 24 feet over guards, the hold is 4 feet 6 inches deep. The propelling machinery consists of two compound engines driving a stern wheel.

Steam Yacht Isis.—At the yard of Messrs. T. S. Marvel and Company there was launched on December 10th the steam yacht *Isis*, owned by Messrs. W. S. and J. T. Spaulding, of Boston. The *Isis* is a twin-screw steamer; length over all, 200 feet; length on water line, 164 feet; beam, 24 feet 6 inches, and draught, 11 feet 6 inches. She will have two Yarrow water tube boilers with forced draft, and the engines will be triple expansion, with cylinders 12, 18 1-2 and 29 inches in diameter by 20 inches stroke. The yacht will be towed to Hoboken to receive her engines to be furnished by W. and A. Fletcher Company.

Monitor Florida.—The United States monitor *Florida* was launched on November 30th from Lewis Nixon's shipyard, at Elizabethport, N. J. The *Florida* is 252 feet long, 50 feet beam; mean draught, 12 feet 6 inches; displacement, 3,235 tons with stores on board, and at normal coal supply. The ship is to have a speed of 11 1-2 knots, driven by twin screw vertical triple expansion engines, indicating 2,400 I. H. P., supplied with steam by modified Normand boilers. The sides are protected by continuous belts of armor 5 1-2 inches thick below the water line and increasing to 12 inches at the water line. The armament consists of two 12-inch guns, placed in single turret with 12-inch armor mounted en barbette, forward. There are four 4-inch rifles and a secondary battery of ten small guns.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

IN the present session of Congress two movements are already under way fraught with the greatest importance for the merchant marine and for the general shipping interests of the country. These are the new shipping bill introduced by Senator Frye, and the movement toward an Isthmian canal, which is now attracting so much attention both in Congress and from the country at large.

Regarding the shipping bill, the details of its provisions will be found on another page of our present issue and need not be repeated here. The main provisions are two in number, the first providing for a readjustment of the payments for the carriage of ocean mails, and the second providing for a general subsidy for all vessels, steam or sail, which are not under mail contracts.

The question as to whether special contracts with vessels carrying the mails and a general subsidy for vessels of all other classes is the best method of building up the merchant marine, is a question for the political economist, rather than for the engineer, and we shall not consider it our duty to discuss in these columns those phases of the question which are more especially political in character. If, however, the general policy outlined in the bill is to be considered as suitable for the purpose in view, and there seems to be abundant precedent for such policy in the legislation of other maritime nations, then we may properly consider the adequacy of the bill as proposed for the purpose to be attained, and we may properly compare the present bill with that proposed at the last session of Congress.

The first section of the bill provides for a complete readjustment of the ocean mail contracts, and is in effect a series of amendments to the ocean mail act of 1891. The general purpose of these amendments is to free the United States postal service of dependence on foreign ships for the carriage of its mails, and to substitute throughout an American system. The new classification of ships in seven classes instead of four is in accord with the modern progress of ship building, and the readjustment of rates of pay is based on the experience of the past ten years with the act of 1891. The rates thus fixed by the bill are the maximum, and the contracts will be open to competition, and awarded as much below the maximum as will secure an American service.

These features of the bill are great improvements over the act of 1891, and should command most careful consideration. While it is desirable that the products of our mills and farms should be carried to our foreign purchasers in American ships, it is perhaps still more desirable that in the carriage of our mails we should be independent of foreign ships, and especially of such as are enrolled on the list of foreign auxiliary cruisers. The most important questions which may be asked in this connection are two: Will the foreign mail service for a time suffer any serious loss of efficiency? And, is the compensation offered sufficient to induce adequate capital to enter the field and provide a service which shall be adequate to the needs of the business world? If the public can be satisfied on these two points, and if at the same time it shall appear that the compensation is only fair for the services rendered, then it is perhaps likely that this section will commend itself widely and irrespective of the specific question of the subsidies provided in the second title of the bill.

This section provides for a general subsidy for all vessels, steam or sail, which are not under mail contracts, and is uniform at one cent per gross ton per 100 nautical miles for not exceeding sixteen entries in one year. The purpose of

this payment is intended to equalize the difference in the cost of building and operating ships in the United States and in Europe. It is just at this point that the chief difficulty in carrying out the principle of the subsidy is found. It is intended to equalize a difference, but as we took occasion to point out in our last issue, no one knows just what this difference is, or what it should be under fairly equal general conditions. Many are opposed to the principle of a subsidy because they believe that this difference is more fancied than real, and in any event that the difference is not as great as the subsidies proposed, and they are opposed on principle to the payment of a premium to any man simply for engaging in one kind of business rather than another. The American ship owner is, of course, the first to agree with his critic in this regard. He does not wish to be made an object of charity, and would be the first to resent such an imputation. He only asks such aid as will make possible at a fair profit the operation of shipping under the American flag in the commercial carrying trade of the world. And thus the trouble arises in satisfying the public at large that this difference is a reality, and that it is not due to the fault of the American shipbuilder, and that the subsidy proposed is not enough more than this to constitute a substantial premium simply for carrying on a shipping business. We would still question whether the information available regarding the items going to make up this difference is sufficiently detailed, accurate and comprehensive, so that all concerned can be safely assured that the figures proposed will be adequate without being excessive. The difficulties in the case seem to arise largely from the uncertainties in the situation, and from the difficulty in devising any system of compensation which shall meet without exceeding the requirements of the situation, and which shall be reasonably permanent for a term of years in equalizing the differences referred to. If the general public could be satisfied that the present bill could be depended on to fulfil these conditions, doubtless much of the opposition which was directed against its predecessor would be withdrawn. In any event it seems fair to believe that the present bill is free from many of the objections which were urged against its predecessor, and that in its general features it is well adapted to utilize the principle of the subsidy for the relief of American shipping.

Regarding the Isthmian canal, the recent ratification of the proposed treaty with Great Britain and its undoubted acceptance by the latter power leaves the way clear for the early consideration and passage of a canal construction bill. It seems fair to believe that there is a very generally distributed desire on the part of the American people for such a canal, and it would seem to be the duty, as we believe that it will be the pleasure of Congress to unite irrespective of party on a measure which shall secure an early construction of the canal and the benefits which it seems calculated to bring.

THE findings of the court martial which was called to investigate the circumstances connected with the foundering of the British torpedo boat destroyer *Cobra* have been made public, and the verdict is, in effect, that the *Cobra* broke in two near amidships, such rupture having been due to insufficient longitudinal strength. This finding is entirely in accordance with the evidence adduced, and it is difficult to see how any other verdict could have been reached. The history of the whole affair, in brief, is that of a boat built at Elswick-on-Tyne on the yard account, and doubtless with the expectation of later effecting a sale to the Admiralty. When completed and offered she was found weak by the inspector, and was considerably strengthened in her decks and other features. She was then bought, placed in commission, and in due course of time ordered from the Tyne to Portsmouth. En route she fell in with bad weather, and, due to the stresses developed among the waves, seems finally to have collapsed and foundered, with nearly all on board.

In this brief career and tragic ending we may find abundant food for thought regarding the suitability of the general type of torpedo boat and torpedo boat destroyer for service at sea. It is true that we have had no indications in our own boats of any such weakness, and it is not likely than any such condition exists. This case does, however, furnish evidence of how small a margin we are likely to have in such designs, and how little change there might be needed to carry any given design across the danger line. The demonstration is perhaps one which was needed to be made, though the loss of life is to be deplored. If the lesson shall be heeded, however, the sacrifice may not have been in vain.

THE CONTEST FOR THE PRIZES.

All articles intended for competition for the two prizes of $15 and $10 each, mentioned in our advertising pages, must be sent in promptly, as the contest will close on December 31.

All articles published will be paid for at the regular rates. The best and the next best will draw the prizes in addition.

Repairing Piston of Dynamo Engine.

On the morning of the 17th of November, 1901, the dynamo engine on the steamship *Curacao* started making an unusual noise. Stopping and taking off its cylinder head, the piston nut was found slack and the

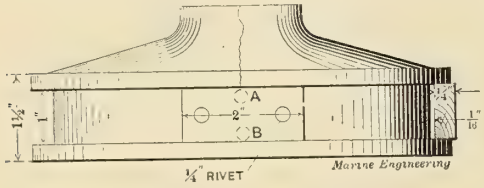


FIG. 1.

piston cracked across its diameter and down one side, as shown at *A*, Fig. 1, and on the opposite side down to *B*. Repairs were made, as shown by the accom-

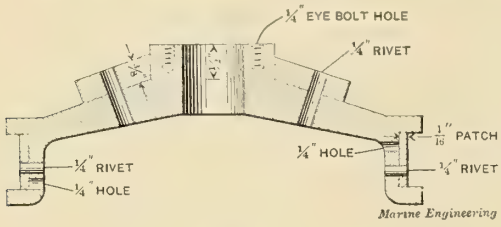


FIG. 2.

panying sketches. One quarter inch holes were drilled at the ends of the crack and patches were fitted. The top patch is a washer such as carpenters use, 4 inches

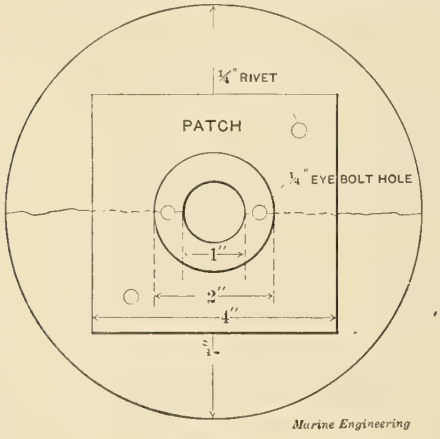


FIG. 3.

square by 3-8 inches thick, of sheet steel and with a hole in it 1 1-2 inch diameter. This washer was heated and dished, the cylinder head being used for a former. The piston boss fillet was also filed, as shown in Fig. 2, and that part left about 1-64 inch larger in diameter than the parallel part of boss, and the patch hole filed to just go over the parallel part. Patches were then put in the packing ring groove, the groove being deep enough to allow 1-16 inch thickness of metal. Rivet holes in these patches were spaced to draw. The top patch was then heated, hung on the parallel part of the boss and squeezed over the filed part in the vise, using a 2-inch pipe coupling against the patch to seat it. In cooling, the crack where it already extended to the lower flange, Fig 1, *B*, went through. The piston was then tried on the rod and with nut set up the crack did not open a particle. Being put in place, the engine was started and has now been running 10 nights without showing the least sign of weakness. The ship is home and a new piston can be had. A patch could not be put on the bottom of the piston because the crank pin bolts were not long enough to allow its being raised, while, of course, the cylinder head could be easily raised with a thick gasket. L.

How a Broken Shaft Was Repaired.

A few years ago I was awakened out of my sleep on the steamship ——, on a rough and windy night, by the first assistant engineer pleasantly informing me that the intermediate section of shaft was broken.

On going into the engine room I found a frightful mess. The water was swashing from one side to the other, and pouring in through a large leak in the circulating discharge pipe through the condenser, close to the hull of the ship. The first thing to be done was to get the water out of the ship and stop the leak. All of the pumps on board which could be connected to the bilge were operated by a link from the intermediate crosshead excepting one small Worthington, 8 by 6 by 6 inches. This latter pump we started up, but soon the ashes, which had washed into the bilge from the fireroom, plugged it up. I shut off the Kingston valve and took out the length of pipe next to the seacock, and thus the suction of the circulating pump opened into the bilge. I then disconnected or broke the shaft coupling just aft the thrust bearing, and started up the main engine to pump out the bilge by the bilge and circulating pumps. The bilge water passed through the condenser, and 75 per cent of it leaked back into the hold through the break in the discharge pipe. There was no check valve on the ship's side. I stopped the engine, took out the broken length of pipe and slipped one end of a canvas ventilator or wind sail around the remaining length and carried the other end up and out of a porthole, which was eight feet above. The canvas was bound in place, the discharge hole in the ship's side plugged up with mats, and the main engine was slowly started again. We did not take long to get the level of water down in the bilge by using both the bilge and the circulating pumps, the latter discharging its water through the condenser and the canvas ventilator overboard through the porthole. I then put the section of inlet pipe next the Kingston valve back in place, and the bilge pump took care of what little leakage there was.

I then went again to examine the shaft, and, because we practically had no tools on board, it appeared doubtful whether the repairs could be made. The company that owns this ship was so mean that they let the captain buy the engineer's supplies. The outfit of tools was made up of only a few wrenches and hammers which were fit for old junk. This was my first trip on this ship; I had joined her on the morning she sailed, and after examining the engine room and outfit I decided that the next port would be my jumping off place, wherever it might be.

However, it was necessary for us to make some kind of a job, as we were entirely helpless and 900 miles from port. The break in the shaft was two-thirds the length of the shaft from the forward coupling. As the boilers were fitted with forced draft, I got some old retarders out of the tubes, straightened them and lashed them lengthwise on the shaft over the rupture. I then cut down some of the wire rigging and wound it round the shaft, starting from the after end and winding it over to the left forward, as the engines were right-handed. I took out a coupling bolt at both the forward and after couplings and put in a ring bolt taken from the deck, and to these I made the wire fast, serving it back and forth, winding in the same direction, so that when the engines should start the tension would bind the wire down hard over the break. Then I made fast a chain to a key placed through the after ring and carried it to the forward ring. Next we bolted up the coupling which we had previously disconnected, and were now ready to go ahead. Steam was turned on very slowly, until it looked as if the wire would not stand the strain. The engines were again stopped, and we spent three hours serving that shaft with chain, which was the hardest part of the job; but when it was done it looked like a bunch of eel grass on the shaft. Upon starting up very cautiously I found to my delight that the shaft next the engine rotated only one-third of a revolution before it brought up solid on the chain, and the propeller end rotated all right. We gradually turned up the engine to 40 revolutions and made about four knots. When we got in sight of land I turned her up to 50, as I was getting reckless, and informed the captain not to go in port with the expectation of the engines reversing, as the chain was so wound that to reverse the engine would be to unwind it, and if he signaled to stop not to be too sure about starting them again. So we were going along nicely, when I ordered the assistant to turn her up to 60 or 65, for, now that we were in the harbor with plenty of tugs around, I wanted to find out how much the gear would stand. But as soon as he started the throttle the chain carried away, but the wire held on for 200 revolutions and then parted. The performance of the wire at this stage surprised me, and no doubt it would alone have brought us in at 40 revolutions, or at least I think so.

The total time taken for making repairs was from Friday morning, 1.30, until 9.30 that night, and our jury rig had carried us 892 miles. Most of the time of the repairs was taken up in repairing the pumps and condenser. The break in the discharge pipe was due to the racing of the engines when the shaft broke.

"CHIEF."

Repair of Broken Bearing Frame and of Small Piston Rod.

While in a heavy blow one day No. 6 frame of the steamship *Corona's* engine started going up and down and in a few moments the journal started to heat.

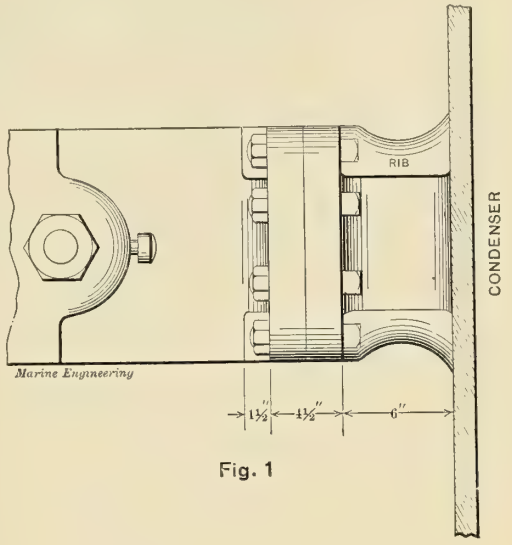


Fig. 1

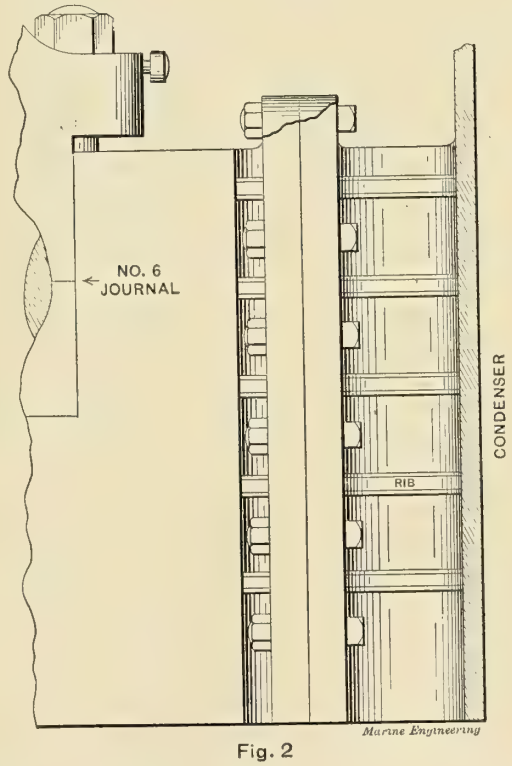


Fig. 2

PLAN AND ELEVATION SHOWING REPAIRS TO ENGINE FRAME.

Stopping the engine, the top of the flange, as shown by the serrated line in Fig. 2, had broken off through the bolt holes. The holding down bolts were then gone over and all the tie bolts in No. 6 frame were set up

hard and the engines were again started at a slower speed, and everything went along all right till the next port—about 100 miles. On investigation it was found that the two top holes had been fitted with turned bolts, all the rest with 7-8-inch rough bolts, and of course the two top holes were out of business. The frame had worked up and down as much as a 7-8-inch bolt in a 15-16-inch hole would let it. No tools being at hand, a reamer, as shown in Fig. 3, was made by one of the engineers, on a lathe kindly lent by the engineer of an electric light station. This reamer worked so well that a wrench could be kept on the

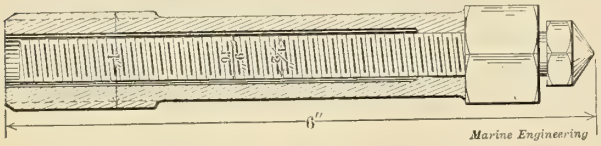


Fig. 3

feed screw continuously. Two holes in the side of No. 6 were then reamed and fitted with turned bolts. Afterwards, as opportunity offered, three holes in each side of each frame were fitted the same way.

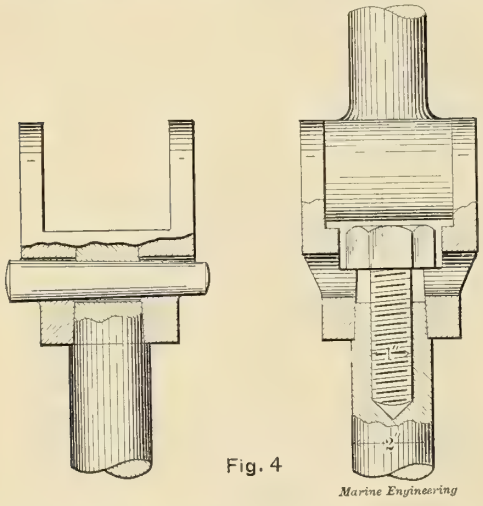


Fig. 4

On the same ship, some time later, the piston rod in the reversing engine parted in the keyway in getting to a wharf. Although the rod had parted, the reversing engine, of course, could still be used one way. The other way the links were pulled over with a chain tackle, thus making the wharf. The job was repaired, as shown by the right hand sketch, Fig. 4, and required about four hours. The rod and crosshead were drilled and counterbored in place, the counterbore being made with just a flat projection for guide while the rod was being drilled and tapped for the stud. Arriving at home a new rod was made and fastened with a nut in the crosshead. Originally, although the key was in double shear, its area was larger than that of the rod surrounding the keyway.

H. L.

Experiences With Injection Valves.

Thinking that the following experiences I have had with injection valves might be of interest for your "mishap" columns, I take the liberty of forwarding you descriptions of the same.

While I was connected with one of the smaller shipyards on the Delaware River, a tugboat came to the yard for a general overhauling. After she had come off the marine railways it was noticed that the joint under the cover on the 8-inch main injection valve was leaking badly. The valve had been ground in and overhauled while the tug was out of the water, but through some carelessness the old gasket had been put back in place, although it was nearly worn out and unfit for further use. I first had the joint set up on as tight as possible, thinking that would stop the leaking, but this did little or no good. I could have driven white pine wedges around the joint and stopped the leak temporarily, but that would look badly on a valve that had just been overhauled. To haul the vessel out on the railways again would have been too expensive, so I determined to try and put in a new gasket while the tug was in the water.

The cover was secured to the body of the valve by eight 3-4 inch studs and nuts, and luckily the studs had not been cut off flush with the tops of the nuts. I accordingly slacked back on all of the nuts about three threads each. I then screwed down hard on the handwheel until the joint was broken and the cover had brought up on the nuts again. I continued this operation until each nut was only held by about two threads on its stud, which gave me a 3-4 inch opening between the cover and the flange on the valve.

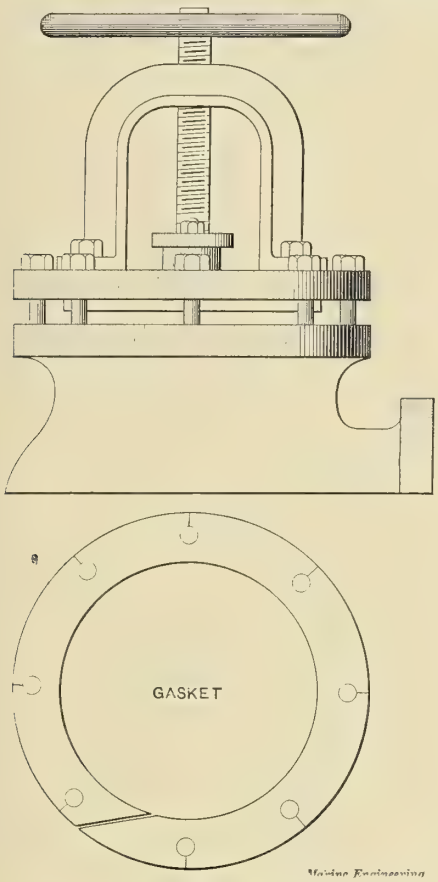
To cut out the old gasket with a case knife was but the work of a few moments. A new gasket was then cut to fit the flange, but instead of being continuous, I cut it diagonally, and opposite each bolt hole I made other cuts extending to the outer circumference of the gasket. Then after rubbing some black lead and tallow on the gasket I succeeded after a half hour's patient labor in getting the new gasket in place by working it around under the cover flange and between the studs. After it was in place the hand wheel was gradually turned back and the nuts set up on, until the cover was down firmly in place. The valve was then opened to the sea, and the joint was found to be perfectly tight.

The sketches on the following page will illustrate the method adopted:

The other instance, while not exactly a "mishap," is certainly one of interest.

It occurred on one of the Philadelphia city ice boats, which are maintained for the purpose of keeping the channel open in the Delaware River during the winter months. It was found that the 16-inch main injection valve would not furnish sufficient water for the condenser owing to its becoming partially stopped up by the jumbled ice which would be drawn up against the strainer. It was therefore decided to fit an additional injection valve. The ice was so thick in the river as to prevent the vessel being hauled out on any of the marine railways, or dry docks in the vicinity, and as her services were badly needed, the almost unheard of task of fitting an injection valve and strainer to the hull while the vessel was in the water was undertaken. To accomplish this a mat about ten feet square was first made from six thicknesses of heavy canvas, quilted

together. The edges were roped and at each corner heavy cringles were fitted, to which guy ropes were fastened. The mat was then worked down under the ship until it covered that part of the vessel's bottom where it was proposed to fit the new valve. The strake of plating to which the valve was to be attached was about 1-2 inch thick. Holes for the strainer were laid off on the inside of the plating and drilled with a ratchet, thus using the bottom of the ship for the strainer. The drill would go through the plating, but by a little care it would not cut the canvas, which was held up tightly against the bottom by the pressure of the water. It was, to be sure, a long and tedious job to drill these hundreds of holes, but it was even-



REPLACING A GASKET IN INJECTION VALVE.

tually accomplished. The pattern for the valve seating was then fitted to the hull of the vessel very carefully, and after it was cast it was chipped to as neat a fit as possible. Holes were drilled through the cast iron flange in the machine shop, and the corresponding holes were drilled through these into the skin of the ship. The holes in the plating were then tapped and studs screwed into them, after which it was a comparatively easy job to fasten the seating in place and bolt the valve to it. After all connections had been made, the canvas mat on the outside was removed and the joints were found to be tight. In fact the job was so substantially done that it has been in use for seven or eight years without any additional repairs made to it.

JOHN QUINCY.

Camden, N. J.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MCALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER V.

The following morning the Professor went on deck early and found that the storm had entirely subsided, although there was still a considerable roll on. The sky was clear, without a sign of a cloud in sight, and there was every indication that the day would be very hot. The sailors were busy about the decks, sweeping and setting the awnings. He first went in to breakfast, and after eating heartily, felt so much refreshed that he decided to devote nearly all day to the engine room.

After a few moments' pleasant conversation with his brother, the Chief Engineer, he put on his overalls and went below. After greeting the engineer on watch, he went down to the lower engine room and met his new-found friend, Barney, the oiler, who was hustling around at his work, humming an old Irish ballad and vigorously smoking his pipe. "Good morning, Professor," said he as he caught sight of the visitor. "I'm going to see what I can do towards using less cylinder ile this morning." "That's right, Barney," replied the Professor. He then went up and spoke to the engineer of the watch and got his permission to reduce the supply of oil in the cylinders. The automatic lubricator on the main steam pipe was then slowed down so that only about two drops a minute passed through. The oiler going off watch at 8 o'clock, had put some oil in the cylinders through the cups screwed into the cylinder covers, as the custom was to give a little oil to each cylinder every hour in this manner. When 9 o'clock came Barney appeared a little fidgety, and said that he was afraid if he did not put some oil in the cylinders she would "grunt," as he expressed it. "We will try it, anyhow," said the Professor.

Noticing the oiler come up on the grating with a two-gallon feeder in his hand, and commence filling up the reservoirs for the automatic lubricating systems, he turned to the engineer and said that nowadays the best practice was to have a 25 or 30 gallon reservoir fitted as high up in the engine room as possible. By means of a pump in the lower engine room connected to the main oil tanks, this overhead tank could be filled without carrying oil around the engine room. To fill the reservoirs on the sides of the cylinders, all that was necessary was to open a cock or small valve and let it run in by gravity. Noticing that these small reservoirs were of the old-fashioned cast brass kind, he stated that the best type he had seen were cylindrical in shape, and that the ends were of glass, so that the height of the oil in them could be seen at a glance. This brought up the subject of automatic lubrication, and the Professor informed the engineer that he believed a great deal of oil was wasted by such methods as those in general use. The regulation of the feeds, he said, appeared to him to be of great importance. If left entirely to the oiler, he would be liable to give the various pins and bearings too much oil in order to be on the safe side, and also to save himself the trouble of getting around and feeling the bearings too often. He said that he was of the opinion that for ordinary running the best plan would be to

give only the crossheads and crank pin brasses steady lubrication, and let all other journals be oiled by hand at regular intervals. The assistant engineer said that he was not very much in favor of automatic oiling either, as he had on several occasions experienced difficulty in having the oil pipes plug up or in having the feed valves clog.

The Professor suggested that these difficulties would probably be overcome if the inside surfaces of the pipes were tinned, in order to prevent the formation of verdigris, caused by the acids in the oil, making a chemical combination with the bare brass of the pipes; and also stated that the oil should be properly strained before it was put in the reservoirs to avoid the "clogging up" of the feed valves. Noticing that they were using lard oil, he asked why they did not use a mineral oil. To this query, the assistant replied that he did not know any good reason for not using it, only that they always had used lard oil since he had been on the ship. The Professor then stated that he had made laboratory experiments with certain grades of mineral oils and found that their lubricating qualities were better than lard oil. In addition to that he said that mineral oils would not smell so badly in the bilges as lard oil, and that he understood that the mineral oil was cheaper. From conversation with many sea-going engineers he said that he had formed the impression that it was only prejudice which prevented them from using mineral oils, instead of the old-fashioned practice of using lard oil for everything. Barney, who had been listening to this discourse, chimed in just then by saying, "Yes; and that hog grease is moighty bad stuff when it gets thrown in your eyes or gets into a cut on your hand."

It now lacked only a few minutes of 10 o'clock, and as yet no "grunts" had been heard from the cylinders or valve chests. However, the Professor suggested that a little cylinder oil be put in the three cylinders. "That's right," said Barney; "she's loike an old toper, it won't do to shut off her allowance too short."

The Professor continued his discourse on lubrication, and said that he had been informed that many engineers used grease compounds wherever possible, some even using it on the main bearings. He said that he considered this as rather bad practice, and that on bearings or journals having comparatively little motion grease could be used with advantage. For instance, he said, grease cups on those journals on the drag links would be all right, and more economical than using oil. He also said that grease cups would be all right on reverse shaft bearings. Coming to the subject of oiling main bearings, he said that he considered it a mistake made by many to put oil in the middle of the bearing only, contending that as the ship always had more or less drag, the tendency of the oil was to run aft and thus leave the forward parts of the bearings unlubricated. Oil boxes on main bearings, he contended, should always be fitted with two wick feeds, one on the forward end of the cap or binder, and the other on the after part.

On the subject of eccentric straps, he said his idea would be to oil them by hand, through a small cup secured to the side of the eccentric rod, and having a pipe leading to the center of the bearing surface on top of the strap. With slide valves the eccentrics had to do considerable work, and unless they are designed with large bearing surfaces they are very liable to warm up. He suggested that to save using such a large amount of oil on eccentrics, as is customarily used to keep them cool, they could be arranged to dip into fresh water held in galvanized iron or sheet brass drip pans secured beneath each pair of eccentrics. Barney said, "Yes, and it's a foine lot of lather you would have by churning up that mineral oil and fresh water in an ould drip pan." "There's where you are mistaken, my man," replied the Professor. "While it is true that the ordinary mineral engine oil will make a lather when mixed with fresh water, there is a non-saponifying grade of oil that will not produce that trouble. Before Barney had a chance to ask questions, the Professor explained that "non-saponifying" meant literally that it would not make soap. "Shure," said Barney, "I wish it would make some soap, as it's little enough we get aboard here to wash our clothes in."

As it was time to oil the piston rods and valve stems, the old oiler got out a tin can, which he had half filled with cylinder oil, and proceeded in a dextrous manner to coat the surfaces of the rods with oil by using a swab improvised from a stick and a bunch of waste. While he succeeded in getting the most of the oil on the rods, there was a considerable portion of it that dripped down on the connecting rods and valve gear. This, the college man thought, was a rather bad practice, so he explained to the oiler that on many modern ships he understood that each valve stem and rod had a separate oil pump secured to the cylinder casing in a convenient position, with a small pipe connecting directly to an oil space just inside of the supplementary gland, in the stuffing-box. By a few strokes of the pump sufficient oil would be forced in to thoroughly lubricate the rod. He went on to explain that for the high pressure valve stem and piston rod there was sometimes a pressure of steam in the oil groove in the stuffing-boxes, and that it was usually the practice to fit a small check valve in each of the pipes connecting the pumps to the stuffing-boxes. "That ought to be a fine scheme," said Barney, "as it won't dhribble any ile over the engine."

"Barney, what becomes of all the oil that drips off the engines?" asked the Professor. "Well," said the oiler, "I suppose the poor fish must get it, as it all goes in the bilges and is pumped overboard." "There, again, the ship is behind the times," said the Professor. "The modern practice is to have the crank pits made water tight, and each fitted with a strainer and drain pipe. All these drain pipes lead into a large pipe, and that empties into a galvanized iron tank fitted in between the frames aft of the bed-plate, and lower down than the bottom of the crank pits. The waste oil is then drained into the tank, from which it can be baled or pumped out about once a watch. This waste oil on some ships is put through a filter and can be used again. That is another contrivance that is coming into use; in fact, every large ship should be furnished with a good oil filter, as it will soon pay for itself in the amount of oil saved by it, which would otherwise be pumped overboard and wasted." Barney

replied that the oil tank scheme wouldn't work, as the discharges from the water service would fill the tank up in very short order. "That is no drawback," said the Professor, "as the water service discharges should lead directly into the bilges and not go into the crank pits at all."

The Professor's attention was next attracted, as it had been on the previous day, to the fact that ordinary tallow was being used in the thrust bearing. Barney was stuffing some rancid tallow in between the rings, and at the same time elevating the end of his nose. "Professor," said he, "can't you get up some way of iling this thrust instead of this stinking tallow?" "Why, yes, Barney; there is a much better method in use on new vessels. Nowadays thrust bearings are so designed that the lower part forms a water-tight box. This is filled with oil, and the collars are about half submerged in it. As they revolve sufficient oil is carried up to thoroughly lubricate the horseshoe bearings. Of course the oil gets warm from the great amount of friction, but it is quite easily kept cool by circulating sea water through a pipe coil in the bottom of the oil chamber. It is the custom with this style of thrust to fit an oil-tight cover, made of sheet iron or brass, over the top of the bearing to keep the oil from being thrown out in the shaft alley." This idea seemed to meet with Barney's approval, and he remarked that he would like to get on a ship with some of the labor-saving devices which the Professor had described to him.

The college man was by this time pretty nearly worn out by the intense heat, and as it was near the noon hour he went to his room, washed up, and ate his dinner. He lingered around on deck for a time, enjoying the welcome shade of the awnings. The ship was now in the tropics, the heat was becoming very oppressive, and the Professor shuddered when he thought of again going into the engine room. However, as he had made up his mind to spend all day there, he reluctantly put on his perspiration-soaked overalls and again went below. The heat was even greater than it had been in the morning watch, so he walked over until he got under one of the ventilators. There he was joined by the first assistant, who had the watch. The Professor told him what success he had met in regard to using less cylinder oil, so the engineer called up his oiler and told him to put oil in the cylinders only twice during the watch.

Looking over at the engine room thermometer, the Professor saw that it registered 128 degrees. The officer on watch assured him that that was nothing unusual, and that he expected it would get even higher than that. This somewhat startled the book man, and he wondered if he could stand it any hotter than it was. The hot air made the membrane in his nostrils smart, and he concluded that, although there were some pleasant experiences in a marine engineer's life, this standing a four hours' watch in the tropics was not to be numbered in that category.

Going down below he found the atmosphere in the lower engine room somewhat cooler, but hot enough at the best. "Why don't you take off your jumper?" said the oiler. This the Professor proceeded to do, and as he stood there, arrayed in undershirt and overalls, he did not present a very dignified appearance, but he found it much more comfortable.

After making a thorough examination of the water service, as that seemed to be the only cool apparatus in the engine room, he rejoined the first assistant under the ventilator. He asked him if they had much occasion to resort to the use of water on the journals, and was told that it was very rarely used, except the regular circulation through the guides and main bearings. The Professor said that he noticed that the pipes over the crank pins were bent in many places. This, the first assistant replied, was caused by the men standing on the pipes when overhauling the engine. The Professor suggested that it would be a good idea to make them of extra heavy pipe and secure them firmly to the main pipe at the back and to the columns in front. "I notice," he continued, "that the main supply pipe running along the side of the condenser is of ordinary brass pipe. In my opinion, it should be of cast brass, eccentric in section and not less than ½ inch thick at the heaviest part. This would give a firm support to the branch pipes, without brazing or bosses, as you have them here." He went on to tell the assistant of a scheme which an ingenious friend of his had arranged on a Government vessel whereby all the discharge pipes from the main bearings were led to one central location and secured to a bracket, the ends of the pipes being spaced about an inch apart. The engineer or oiler could then tell by running his hand through the several streams if any of them appeared to be warmer than the others. In this way his friend claimed that he could at once ascertain whether any of the bearings were becoming the least bit heated, and just which they were. The same arrangement could be applied to the discharge pipes from the guides.

In order to observe the working of the air pump, the Professor walked around back of the engine and stood there in meditation for awhile. He suddenly felt rather faint and everything began to look black before his eyes. He made a rush to get out of the engine room, and as he half stumbled out of the door the ship's doctor happened to see him in time to prevent him from falling on the deck. Summoning one of the waiters, he shouted: "Run quickly and get me some ice; the Professor has been overcome by the heat."

Mounting Blueprints.—A correspondent of the *American Machinist* gives his method of mounting blueprints for use in the shops as follows: The advantages of this method are that first, prints that have become out of date owing to changes in the drawing, can be easily cut from the boards and new ones put in their places; second, one of them was never known to warp, all lying as flat as the traditional pancake, and third, it is a much simpler process, as I mount them dry and do not have to put them in a press.

I make the prints an inch or two larger each way than the boards I am to mount them on, and clip the corners down to the size of the boards. Then I fold the margins around to the back side of the boards and fasten the edges down with paste, preferably Higgin's Photo-Mounter. This way also gives protection to the edges of the cardboard and it never frays out at the corners.

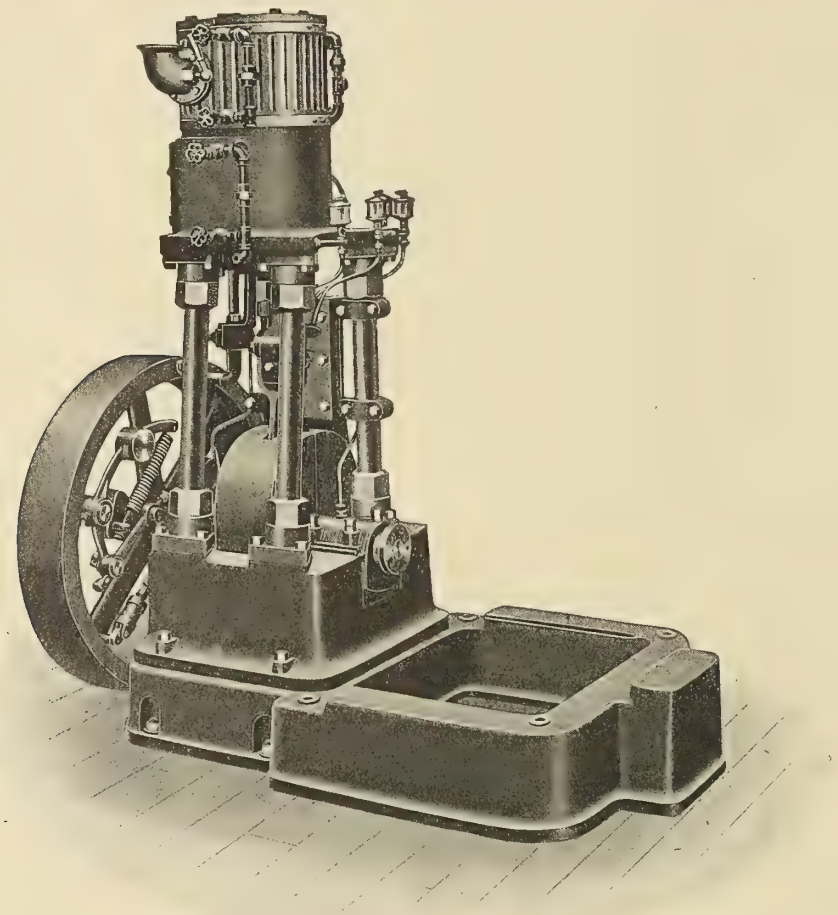
DIRECT CONNECTED ENGINES FOR SETS.

Marine Steeple Compound Engine.

The accompanying cut illustrates a type of marine engine manufactured by the Buffalo Forge Company, of Buffalo, N. Y., and recently applied to service on the great lakes. It is built on steeple compound lines, with the high-pressure cylinder superimposed upon the low-pressure cylinder. The high-pressure cylinder is cast in one piece with its lower head and valve chest. The latter, being circular to accommodate a valve of the piston type, is bored out to receive two cast iron bushings or cages, which are drawn simultaneously in place, one from either end, and in turn bored to form seats for the valve. The high-pressure valve itself is constructed of two hollow pistons, so carried on the valve spindle as to admit of independent adjustment. Each piston of the valve has a single snap ring, which forms its entire bearing face, and which is clamped between two side plates by means of three bolts. After the valve has been constructed, it is carefully turned down to a working fit in the valve chamber. If at any future time it is desired to compensate for wear, the locking bolts on the valve pistons are loosened to allow the snap rings to expand, after which they are again tightened. A very ample space is allowed for lagging the high-pressure cylinder, which finally receives a polished, corrugated covering.

The low-pressure cylinder is fitted with a D slide valve carried on the same spindle with the valve above. Large port openings are provided and a removable plate gives access to the valve for adjustment. The low-pressure cylinder has the lower head cast as a part thereof, together with extensions for the attachment of the frame.

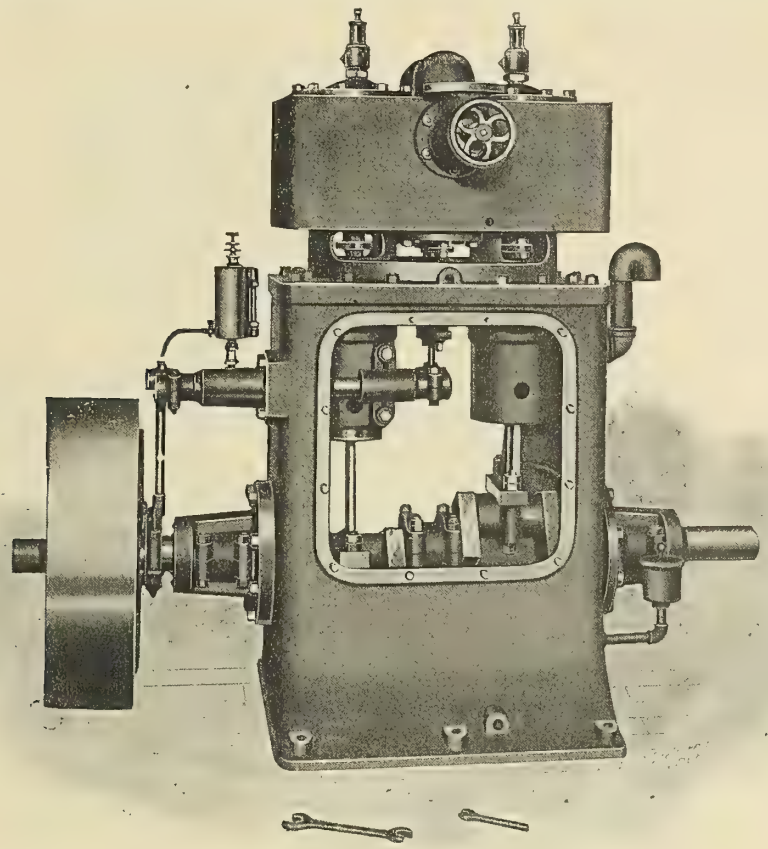
The frame is composed of rods of cold rolled steel, four in number, two perpendicular ones at the rear and two in front, slightly inclined. The maximum stress coming upon any one of these rods, of course, but slightly exceeds in value one-fourth of the maximum piston rod stress, and hence it will be apparent that in this style of frame construction a very high factor of safety is combined with maximum accessibility of the moving parts. This solidity affords also freedom from vibration, which feature is further enhanced by the mode employed for securing the rods to the head and base. On both ends of the several rods a large jam nut firmly holds a triangular pad, which is itself bolted to the base or the low pressure head flange, as the case may be. On the two rear posts is bolted the guide plate, and though the direc-



STEEPLE COMPOUND ENGINE.

tion of rotation is such that the guide pressure is always taken up by this plate, the crosshead shoe is fitted with auxiliary enclosing guides bolted to the main guide plate. The connecting rod at its upper part has a forked end, while the other end is of the locomotive strap and wedge type. The crank shaft is of forged steel, large in diameter, with long bearings in the base and is provided with counter weighted crank discs.

The base is carried on a sub-base which gives the fly-wheel the proper floor clearance, and which, in this instance, is arranged for directly connecting to the engine an Elwell Parker Electric Company generator. Close regulation is afforded by a governor of the centrifugal fly-wheel type, and by reason of its three means of adjustment, together with the provision of oil or grease cups on all the governor pins and on the various bearing surfaces of the valve motion as well, great sensitiveness may be secured. Abundant lubrication is characteristic of the engine and is assured by a series of sight feed oil cups feeding the rubbing surfaces through brass tubing. The arrangement is such as to cause the oil after use to drain into the crank pit, whence it may be drawn and filtered as desired. In the engraving is shown the device for trapping the oil escaping from the outer ends of the main journals. The lubricant from the end of the bearing is guided by a plate into a narrow receptacle on the outside of the bed, from which connection is made with the crank pit. In order to prevent the projection of any particles of oil from the rotating parts, a light polished hood is furnished, as shown. The material used in the building of this engine is the very best, and in point of nicety of construction and finish, it is in perfect keeping with the best marine engine practice.



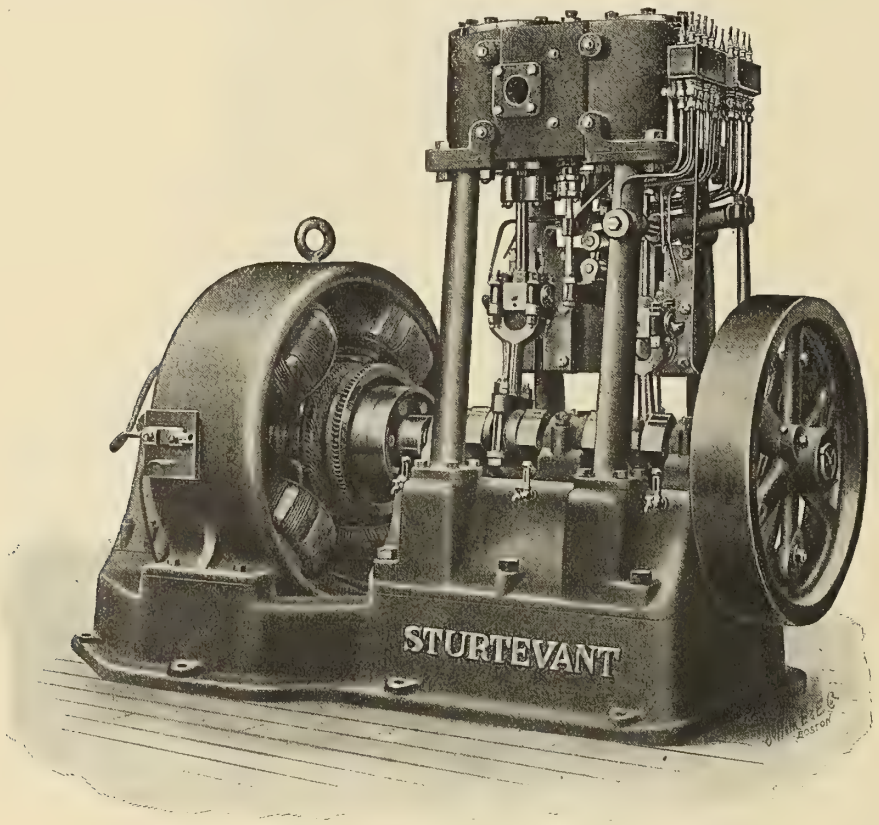
AUTOMATIC CORNISH CYCLE ENGINE.

A Cornish Cycle Engine.

The design of the automatic Cornish cycle engine, built by the Fuller Company, Detroit, Mich., is such as to produce an engine that will run noiselessly at the highest speed of revolution. The natural difficulties of the ordinary double acting engines for high speed has led to the introduction of the single acting type for that service, and, while this type eliminates some difficulties, it has its own inherent disadvantages.

The engine here illustrated embraces many of the advantages of both types. This engine is set vertical, and has the usual cylinder, piston, rod, crosshead, guides, connecting rod and double cranks of the double-acting type, but the operation of the steam on the piston is entirely different, the so-called "Cornish cycle" being adopted, and it is the only engine of the type made in America for high speed. The high-pressure steam is admitted to the top of cylinder only. After having done its work there it is transferred below the piston by the valve establishing equilibrium between both ends of the cylinder, and closing at the proper point on the up-

stroke of the piston to prevent any tendency of the connections leaving the crank pin. On the down stroke the steam is exhausted to the atmosphere, or to a condenser, where the vacuum forming under the piston removes the back pressure. Thus the piston is, at all times, whether working condensing or non-condensing, exerting a downward pressure on the crank pin, which enables the engine to run noiselessly at high speed. The stuffing-box of the piston rod is in the open space between cylinder and crank case, and being on the low pressure side of the cylinder can be quite slack and free from friction. The engine is of an enclosed type, with splash lubrication, which offers many advantages when



COMPOUND ENGINE DIRECT CONNECTED TO GENERATOR.

run at high speed. The Rites single weight governor is fitted and will regulate within 2 per cent. The engine is built of the best material and workmanship, with single or double cylinders, compounded if desired, and is adapted to any service where a noiseless, high-speed engine is required.

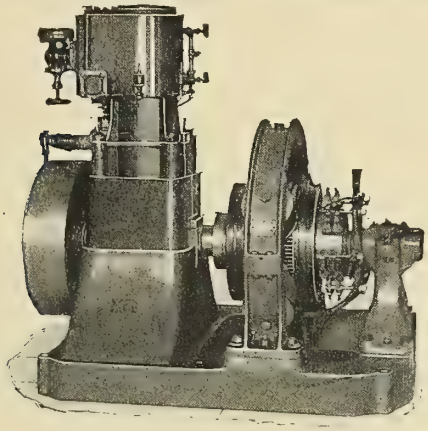
Compound Engine Generating Set.

In the accompanying illustration is presented a design of one of the direct connected generating sets built by the B. F. Sturtevant Company, of Boston, Mass. This company started with the building of motors for direct connection to fans, but is now turning out an engine in over one hundred sizes and under 250 horse-power, for running fans and dynamos. The engine is of the vertical compound open type, and the generator is a 4-pole type. In this design the bed carries three main journal bearings, brass bushed in their lower halves and provided with continuous oiling devices in connection with oil reservoirs beneath. Its interior is formed into a basin, which collects all drip from water or oil. The four heavy upright columns are securely fastened to this bed, and to the upper ends is bolted the single cylinder casting, comprising the two cylinders, which are of relatively large diameter and short stroke. Two piston valves are operated in unison by a single rocker and yoke, each regulating the admission of steam to one cylinder. The crossheads are of the slipper type with projecting crosshead pins, the connecting rods have yoked crosshead pins and are of large size. Both connecting rods and crossheads are of forged steel, and all parts of the engine are of the highest grade as regards material and workmanship. The cylinders are thoroughly lagged. Complete sight feed oiling arrangements are provided for all bearings. These engines are built in sizes 6 1-2, 11 by 5 1-2 and 7, 13 by 5 1-2, with output at 150 lbs. of 47.5 and 60 H. P. The armature shaft is direct connected to the engine shaft and carries an armature of the barrel wound toothed drum type, with slotted discs of carefully annealed sheet steel, which, after being coated with an improved insulating varnish, are mounted upon a cast iron drum. This drum is provided with longitudinal air ducts, which connect in turn with radial ducts passing through the core, and by means of small blades

or vanes inserted in these ducts, compel the circulation of a constant current of air, thereby greatly facilitating ventilation and insuring an extremely cool running armature. The winding for all low voltage machines is of copper bars. High voltage or very slow speed machines have the armature wire wound with machine-formed coils, which coils are thoroughly insulated before being placed upon the core. The magnet frame is of special magnet steel and has the field cores cast therewith. The ring is cast in one piece. The commutator consists of drop forged segments of pure copper, mounted upon and secured between cast iron flanges of spider construction which allow a circulation of air inside as well as outside, thus conducing to low temperature. Carbon brushes only are used in these machines and mounted in holders of the sliding socket type, with easy facilities for adjustment and removal. A full load run for a sufficient length of time to bring every part to its maximum temperature has never been found to produce a temperature rise exceeding 40 degrees centigrade.

Direct Coupled Power and Lighting Plants.

The appearance of the small, direct coupled generators of the General Electric Company is shown in the accompanying illustration. The present design of



SIMPLE ENGINE DIRECT CONNECTED.

these machines is the result of numerous experiments and a practical experience of many years. For small installations, where a separate engine is necessary to drive the generators, these sets will be found to be nearly as cheap as belted machines. They are compact and simple in arrangement, and for small isolated stations, where space is limited or belting objectionable, they are much desired. The engines require a minimum amount of attention, and, for machines of this size, are very efficient. The generators are of the multipolar type and are compound wound. They regulate automatically within 2 per cent over the entire range from no load to full load, no change being required in the field regulating rheostat and the brushes remaining at the neutral point. The engines are of two types, vertical single cylinder and vertical tandem compound. Where high pressure steam is available and economy of operation an essential consideration, the tandem compound engines give the best efficiency. The compound engines have been adopted by the United States Government for the vessels of the navy. Special attention has been given to the system of lubrication of these sets, and all parts are oiled automatically under pressure, thus reducing the labor to a minimum and ensuring perfect lubrication. The vertical single cylinder engines are as economical as any engine of this type on the market. Both types possess the same desirable features, namely, simplicity, compactness, stability and durability.

Windlass and Capstan for the Siberia.

The accompanying illustrations show a plan and side elevation of the steam and hand windlass, with warping capstans, furnished for the steamships *Siberia* and *Korea*, building at the works of the Newport News Shipbuilding and Dry Dock Company for the Pacific Mail Steamship Company. The windlass is designed for handling 3-inch stud link chain cables at a speed of about five fathoms per minute. The windlass proper is mounted on three bitts, carrying two wildcats with locking gear and a worm gear. A double inverted vertical engine, mounted on a bedplate, common to both windlass and engine, drives the windlass by a worm which runs in an oil-tight casing beneath the worm gear mentioned above. Provision is also made for working the windlass by hand by means of pump brakes. The wildcats, which are loose on the shaft, are fitted with a positive locking device, so they can be easily connected or disconnected from the windlass. Friction band brakes of large diameter are fitted to each wildcat, the bands being operated by compressor wheels, as shown, and having ample surface to "ride by" with the windlass unlocked. On the ends of the windlass shaft are securely keyed gypsy ends, with barrel 27 inches in diameter, for handling heavy hawsers.

The engine cylinders are 16 inches diameter by 14 inches stroke, designed for a working steam pressure of 200 pounds per square inch.

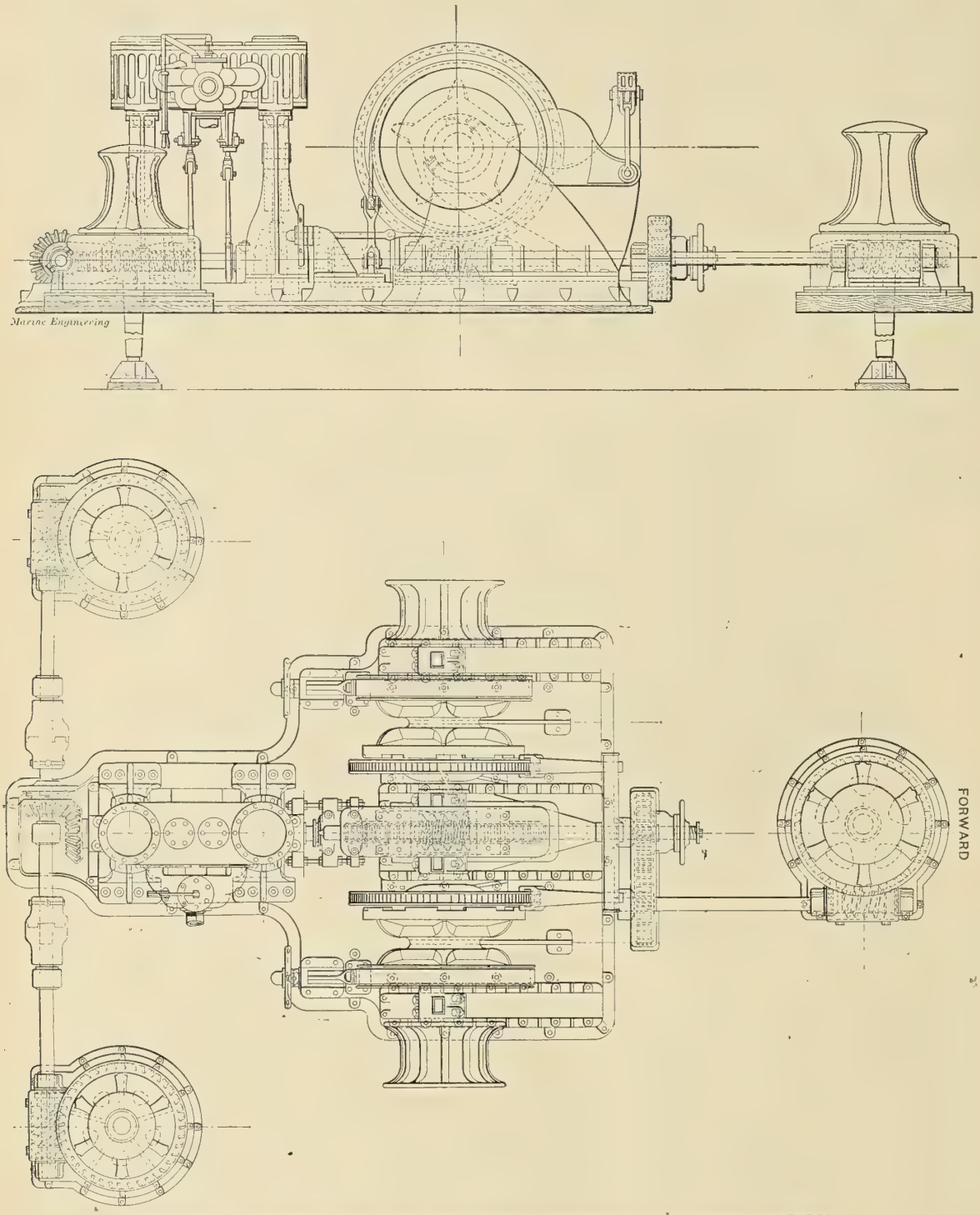
The worm and crank shaft are coupled together by a flange coupling. The thrust of the worm is taken on an independent thrust bearing adjustable for wear in either direction, and so arranged that the collars on the worm shaft will be solid with the shaft and run on white metal thrust surfaces.

The three warping capstans shown in the illustration are operated by the windlass engine, and can be run at the same time as the windlass, or any one of them may be disconnected and run independently. The capstan located forward of the windlass has a barrel of 20 inches diameter. This capstan is turned by means of single-thread worm gearing with a ratio of 40 to 1. The counter-shaft, which carries the worm and clutches, is connected to the continuation of the worm shaft by spur gears of such size as to bring the capstan on the center line of the ship. The two speed capstans located aft of the windlass, one on either side, are driven from the engine crank shaft by bevel gears and four-threaded worm gearing, which has a ratio of 10 to 1. Clutches for disconnecting either capstan are furnished as shown.

The total weight of windlass and capstans is 50

tons, which fact emphasizes the great power and strength necessary to warp these large steamships and handle their heavy chains and anchors.

New Ships.—The Townsend and Downey Shipbuilding and Repair Company, of New York, have contracted to build in their shipyard at Shooters Island,



WINDLASS AND CAPSTAN FOR THE NEW PACIFIC STEAMSHIP CO.'S STEAMER SIBERIA.

These machines were designed and constructed by the Hyde Windlass Company, of Bath, Me., who are also furnishing the cargo winches, warping capstans for the stern, and Brown's patent steam tiller and hydraulic telemotor for these ships.

Borough of Richmond, two steel freight ships of the following dimensions: Length, 360 feet; breadth, 50 feet; depth, 29 feet; cargo capacity, 6,000 tons. They will be built for the Standard Oil Company, to be used in carrying oil in bulk.

SPARKING PRODUCED BY DEFECTIVE COMMUTATORS, AND THE REMEDY.

BY WM. BAXTER, JR.

In order that commutator brushes may run without sparking, the first requirement is, that the machine be properly proportioned. The next requirement is that the commutator be true and the brushes firmly but elastically held, so that they may not separate from the surface of the commutator at any time.

If the commutator is set so as to be eccentric with the shaft, it may run well, providing the diameter is large and the velocity low, but with small diameters and high speed, the brushes will be thrown off every revolution, when the low side comes around, and at these instants a spark will be produced. If the machine is allowed to run in this condition the sparking will continuously increase, because as the sparks will pass when the low side is running under the brush this side will be made still lower by the disintegrating action of the sparks.

If a commutator is set so as to run true with the shaft, but has one or more flat spots, then every time these pass under the brushes there will be sparking, and as in the case of an eccentric commutator, the longer the machine runs the worse the sparking will become. From this it will be seen that if the commutator surface does not run true sparking cannot be prevented. Therefore the only cure in such cases is to true up the surface. The use of sand paper for this purpose is of very little service. It will produce a noticeable difference in the sparking for a short time, simply because with a smooth surface the brushes are less liable to bounce when passing from the low to the high parts, but an effectual cure cannot be made without turning or grinding the commutator surface so that it will run true. In the case of a generator, this trueing can be done by running the machine with the brushes removed, and then rigging up a temporary rest to hold the turning tool. To do such a job a man must know how to use a hand turning tool, for as every one who is an expert in turning knows, a novice cannot hold the tool so that it will not follow the depressions in the work, and nine out of ten will not even be aware of the fact that the tool is simply scraping off the surface without removing the high spots. Turning and grinding attachments for trueing up commutators are made in several designs, and are provided with means for attaching them to the frame of the generator. For all except those skilled in the art of hand turning, these attachments are indispensable.

The commutator of a motor is not so easily trued up, because the machine is not so set up that it can be driven by some external power. In most cases the easiest way to do the work is to place the armature in a lathe. When this is done care must be taken to ascertain whether the bearings on the shaft run true when the latter is run on the centers. In many cases it will be found that the bearings run eccentric, and if such is the case, the best course to pursue is to place the motor, if possible, in a position where it can be driven, and then turn the commutator off while the armature is running in its own bearings. If this cannot be done, then place the armature in the lathe and support the commutator end in a steady rest set at the center of the bearing. In this way the commutator surface will be turned off so as to run true with the bearings at its end of the shaft; and if it is not perfectly true with the other bearing the effect will be to cause it to wobble slightly, but not enough to affect the action of the brushes; that is, in machines of ordinary size and run at ordinary speeds.

In some cases commutators appear to run perfectly true, and yet, when in operation, for some unaccountable reason, they suddenly begin to spark badly. Such cases are generally caused by loose segments, which at times retain their true position, and then from a sudden jar or increase in speed are thrown out of position, and are thus either above or below the surface of the commutator.

In small commutators loose segments always rise above the surface, but in large commutators they may rise above or drop below. Why there is this difference in the two cases can be made clear by means of Figs. 1 and 2. The first one of these illustrations shows a small portion of the surface of a commutator of small

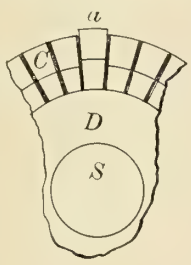


FIG. 1.

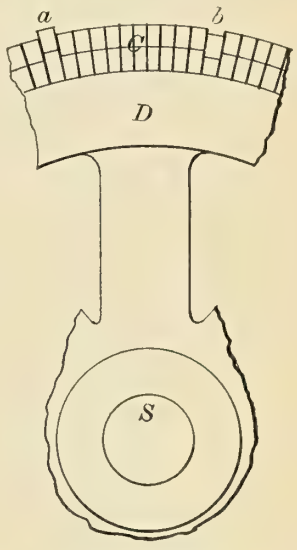


FIG. 2.

diameter. As will be seen the segments are much wider at the face than at the bottom; therefore, if one becomes loose, it will be able to rise above the surface, as shown at *a*, but it will not be able to drop down, for the slightest depression will tighten it up. In Fig. 2, which shows a portion of the surface of a commutator of large diameter, it will be noticed that the difference between the width of the segments at the surface and at the bottom, is not very much; therefore, a loose segment could drop below the surface a considerable distance without becoming wedged. Thus it will be seen that with large commutators a loose segment can drop below the surface, as shown at *b*, just about as easily as it can rise above, as at *a*. From these facts it is evident that if a segment becomes loose in a small commutator it can be tightened and restored to its true position by simply inserting additional insulating material between it and its neighbors, and then tightening up the end clamping ring.

In the case of large commutators, if the loose segment drops below the surface, it will be necessary to place additional insulation under it, as well as on the

sides, for no matter how tightly it may be held sideways, it will be liable to be depressed unless it rests upon a solid foundation.

The material used for commutator insulation is mica, and sometimes asbestos is mixed with it, either in the insulation under the segments, or in that at the ends. A small thickness of asbestos at either one of these places is advantageous because on account of its compressibility it will give until the insulation at other points is forced down to a solid bearing by the pressure of the end clamping ring. It can be easily seen that if the insulation between the segments is made of mica, which is practically incompressible, the diameter of the outer surface of the commutator cannot be reduced below a certain point, for to reduce it it would be necessary to compress either the segments or the mica. If likewise the layer of insulation under the segments is made of pure mica, and therefore incompressible, the segments cannot be drawn down below a certain diameter, and if this diameter is not small enough to take up all the slack between them, some will remain loose. If the insulation in the under layer is built up in part of mica and in part of asbestos, then it will be slightly compressible, and on that account it will be possible to squeeze it up until the segments come together tightly. Under these conditions all the slack may not be taken out of the under layer of insulation, but it will be compressed sufficiently to hold the segments firmly, so that they cannot be depressed.

The ends of the commutator segments, against which the clamping rings bear, are turned off truly in the majority of machines, but in clamping up the commutator, the segments are liable to be forced slightly out of true. Therefore, if the insulation at the ends is an incompressible mica ring, it will not give to the irregularity in the form of the ends of the segments, and will not hold all of them with an equal degree of firmness. If, however, this insulation is made in part of asbestos, so as to yield slightly, then if in clamping up the segments, their ends are forced a trifle out of true, the give in the insulation will compensate for this irregularity, and all the segments will be securely held.

If every part of a commutator is made strictly accurate, it can be put together with solid mica insulation at all points and be perfectly firm, but from the foregoing explanations it can be easily seen that the degree of accuracy required is beyond practical attainment. Even when the bottom and end insulations are made compressible, by the admixture of asbestos, it is necessary to proportion all the parts with the greatest of accuracy to obtain a firm job. In many cases where pure mica insulation is used, a considerable amount of insulating varnish is placed between the layers of mica, of which the sheets and rings are made, and when the structure is tightened up it is heated, thus softening the varnish so that it may be forced out at the points where not required. This process makes a tight commutator in a new machine, but in the course of time the constant heating of the commutator will allow the varnish to work out from other parts, and thus loosen some of the segments.

When a loose segment is to be tightened up the end clamping ring will have to be removed. In some very large generators, this ring is made in a number of sections, each one being held in position by two or more screws. In a machine of this design, the section of the clamping ring that covers the loose segment can be removed, and then the additional insulating material required to make the segment tight can be inserted, and the clamp replaced. In this operation there will be no danger of the segments that are uncovered becoming so loose or displaced that they cannot be forced back into position when the clamp is restored, because the varnish used with the insulating material holds the segments together so that they form a solid mass. If the whole clamping ring has to be removed, then the segments will have to be supported, for if not they may drop out of place so that they cannot be brought back into their true position when the clamp is replaced. A very easy way to hold the segments is illustrated in Fig. 3. The cord *e* should be small and hard twisted, having as little stretching quality as possible. It should be wound tightly around the commutator, making as many turns as the surface will hold. When fully wound, hard wood wedges are forced in as shown at *a a*, one on each side of the defective segment. The best plan

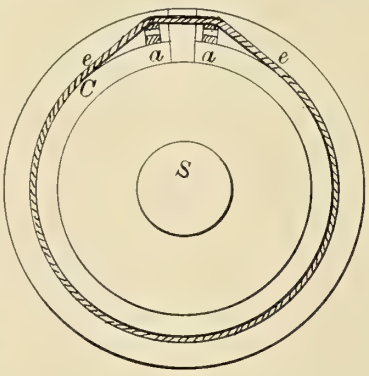


FIG. 3.

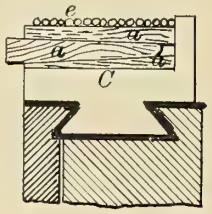


FIG. 4.

is to use three wedges, as shown in Fig. 4, the top and bottom ones being placed under the cord when it is being wound. These two wedges should be very thin and the center one should be thick. The advantage of this arrangement is that in driving the middle wedge, the cord is not forced out of place, as it is very liable to be if a single wedge is used.

When the segments are securely clamped by means of the cord bands, as in Fig. 3, the clamping head can be removed, and the loose segment can be tightened up. In putting in additional insulation to tighten a loose segment it is necessary to place the material where it is required. Thus if the segment is simply loose, so that it rocks from side to side, then additional side inulation will be required; but if it drops below the surface, insulation will have to be placed under it as well as on the sides. If the segment rises above the surface, then insulation will have to be added at the ends where the end clamping rings press.

Sometimes when an armature becomes short circuited, the defect is found to exist in the commutator, and is due to defective insulation caused by oil impregnated with metallic dust, which from time to time finds its way to the end of the commutator. In cases of this kind, the existence of such short circuits can be judged

from the general appearance of the commutator. If it has an oil-soaked appearance, it is reasonable to infer that some of the segments are short circuited through impairment of the insulation. Defects of this kind will be noticed principally in motors, for in generators, armature short circuits result in burn outs before time is given to discover their existence.

Whenever it becomes necessary to remove the end clamp from a commutator, to look for defects of any kind, the rope clamp of Fig. 3 can be used; but, as in such cases it is desirable to turn the armature around freely, while inspecting it, it is advisable to use two

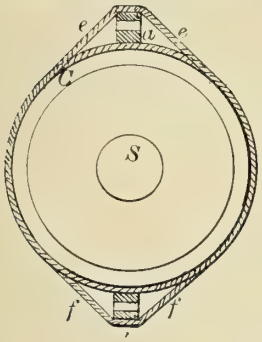


FIG. 5.

FIG. 6.

clamps, as is shown in Fig. 5, and if the commutator is of very large diameter even four may be used, as in Fig. 6. If two clamps are used, each one must cover one-half the commutator surface, the center being taken up by one clamp, and the front and back by the other, this latter being made in two bands. With three clamping bands, each one will occupy one-third the surface, and with four, each one will be of a width equal to one-fourth of the surface. A very good way to make these bands is to use narrow belting, winding it one, two or three layers deep, according to the size of the commutator. For small machines, however, strong cord is the most easily managed, and is entirely satisfactory.

Boston Technology Excursion.—Under the direction of Professor Peabody, the fourth year class in naval architecture at the Massachusetts Institute of Technology recently left Boston on the steamship *Howard* to visit the leading shipyards on the Atlantic coast. On the run to Norfolk a speed and power trial were conducted by the students. The latter part of the excursion was devoted to visiting the yards at Newport News, Sparrows Point, Washington Navy Yard, New York Shipbuilding Company and the William Cramp Ship and Engine Building Company.

The shipbuilding industry in the United States, exclusive of the United States Navy Yard, according to a preliminary report of the Census Bureau, just issued, had a total invested capital of $76,699,651 in 1900. This is an increase of 181 per cent since 1890. The value of products, including custom work and repairing, was $73,444,753, an increase of almost 93 per cent. There were 1,083 establishments and 46,121 wage-earners, with total wages of $24,388,109; miscellaneous expenses, $3,582,257, and cost of materials used was $33,031,280.

TECHNICAL PUBLICATIONS.

The Royal Navy List Diary and Naval Handbook for 1902, paper covered, 120 pp., 6 by 9 1-4 inches, price 75 cents net, foreign postage, 16 cents, Witherby and Company, 326 High Holborn, London, England.

This book contains much historical and statistical information respecting the Royal Navy, its administration, strength, stations and cost, statistical abstracts of all matters concerning service, astronomical notes and tables, tables of tides and tidal constants, and a calendar of notable naval events. There is also a complete obituary of the year, with details of the war and meritorious services of deceased officers of the Royal Navy, the Royal Marines and the Royal Naval Reserves, and an exhaustive summary of the year's naval progress. Then follows a large diary, with index and blanks for reports on gun practice, and other items of interest to naval officers.

How to Build a Three-horse Power Launch Engine. By E. W. Roberts. Size 10 x 12½ inches, pp. 66. Gas Engine Publishing Co., Cincinnati.

This book is specially intended for the increasing class of amateurs who may wish to build such machinery for their own use. The writer is the author of *The Gas Engine Handbook*, and has had much experience with machinery of this character. The immediate purpose of the author is to furnish a design for a complete launch engine for a small boat, together with all the necessary instructions for its construction in the shop. The text is accompanied with fourteen full-page plates reduced from a set of working drawings, and showing in detail and with full dimensions all parts of the machinery. The text is clearly written, and contains many useful hints regarding the construction of the machinery, as well as a considerable amount of useful discussion relating to such machinery in general rather than this design in particular. With the aid of this book any good mechanic, or any amateur with the aid of a mechanic, should be able to provide himself at moderate cost with a small motor of standard type and excellent general design. This book may be cordially recommended to those who are interested in such machinery, and especially in the details of its design and construction.

SELECTED MARINE PATENTS.

686,780. PROPELLING AND STEERING OF BOATS. MATHEW J. STEFFENS, CHICAGO, ILL.

686,883. LIFE-SAVING APPLIANCE. CHARLES BASWITZ, BERLIN, GERMANY.

CLAIM.—As a means for imparting buoyancy to life-preservers and other articles, a mass of kapok fiber enclosed in a flexible sack of suitable material.

687,077. DIVING DRESS. FREDERICK H. SPRANG, LONDON ENGLAND.

CLAIM.—A diving dress made of a inner fabric, coated with vulcanized rubber on its outer surface, and an outer fabric cemented thereto, the pieces of the outer fabric being larger than the corresponding pieces of the inner fabric and alone being stitched together, each seam with the adjacent inturned margins of the outer fabric being proofed by a cover strip of vulcanized rubber-coated fabric cemented both to the inner fabric and to the intervening portions of the outer fabric.

687,241. MOTOR FOR PROPELLING BOATS. JOHN F. KERNS, BUFFALO, N. Y.

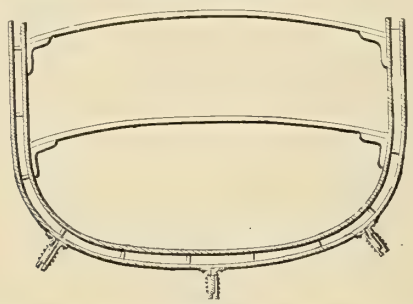
CLAIM.—A means for propelling boats, comprising walking-beams, a propeller, two independent mechanisms connected to

the propeller, means for operatively connecting either of said mechanisms to the walking-beams, and means for rocking the walking-beams.

687,325. SCREW PROPELLER. JAMES B. MACDUFF, BROOKLYN, N. Y.

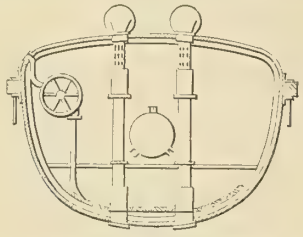
CLAIM.—The combination with a hull or body of a vessel provided with runners and a keel, of braced bearings mounted upon the deck platform of the vessel, a shaft journaled in said bearings, an air propeller having a hub rigidly connected with said shaft, and provided with a surrounding hood or shield adapted to confine the air within the radius of the blades, and to serve also as a fly-wheel; a transverse drive shaft, gearing between said drive shaft and the propeller shaft, and means for operating the drive shaft, substantially as described.

687,398. ARMOR PLATE. DAVID W. GARRIGUES, WOODBURY, N. J. ASSIGNOR OF ONE-HALF TO ELBERT A. CORBIN, PHILADELPHIA, PA.



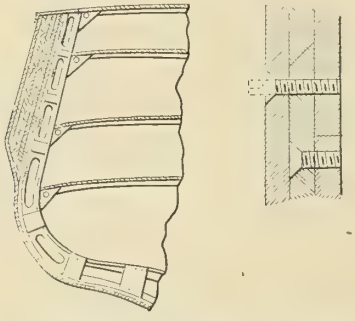
CLAIM.—Armor for a battleship, consisting of a series of superimposed layers, each composed of a series of plates arranged substantially in the same plane and parallel to each other, and in which the fiber or grain in the plates of each layer is arranged at a different angle than the fiber or grain of the adjacent layer or layers, and, further, in which the plates of the outer layer extend downward and over the lower edges of the remaining plates and united to the bottom of the vessel so as to form a continuous sheathing over the portions of the armor of less vertical depth.

687,638. VENTILATING APPARATUS FOR LIFE-BOATS. JAMES MAIN, LIVERPOOL, ENGLAND.



CLAIM.—In a life-boat, the combination of a ventilating-tube open and perforated at each end with a sleeve or band slidably mounted thereon at each end to automatically cover and uncover said perforations to exclude the entrance of water and permit the free entrance of air in all positions the boat may assume, substantially as described.

687,910. CONSTRUCTION OF VESSELS. JOHN S. WATTERS, NEW ORLEANS, LA.



CLAIM.—The combination with a hull of a vessel, of the keel secured thereto, apertures transversely disposed in said keel, and resilient tongues secured at their forward end to said keel and projecting rearwardly into said apertures.

The combination with the hull of a vessel, of a plurality of keels provided with transverse apertures, and resilient tongues secured at one end in front of said apertures and projecting rearwardly into said apertures and having the rear end free, substantially as described.

The combination with the hull of a vessel, of a keel made of two parallel plates secured thereto and provided with transverse apertures, of a plurality of resilient tongues bolted between said plates and having their rear ends free and projecting into said apertures, substantially as described.

The combination with the hull of a vessel of one or more webs, fins or keels running longitudinally and secured to the outer and resilient tongues, each secured at its forward end to said web, fin portion of said hull, with apertures in said web, fin or keel, or keel, and projecting rearwardly into said apertures with its rear end free, substantially as described.

688,135. AIR-SHIP. JOHN SPIES, PHILADELPHIA, PA.

688,398. MEANS FOR ALTERING THE TRIM OF MARINE CRAFT. WILLIAM A. DODGE, FALL RIVER, MASS.

CLAIM.—Means for altering the trim of a marine craft, consisting of two stand pipes near opposite portions of the hull, a tube connecting said stand pipes and provided with zigzag or spiral portions, a mass of heavy liquid in said pipes and tubes, and means for forcing said liquid from one stand pipe to the other.

Means for altering the trim of a marine craft, consisting of stand pipes at opposite points of the hull, a tube connecting said pipes, a mass of heavy liquid in said pipes and tubes, loose pistons in said pipes resting on said liquid, and means for forcing the liquid from one pipe to the other.

688,584. AIR-SHIP. ROBERT H. BOOTS, ALBUQUERQUE, NEW MEXICO.

688,607. VESSEL SOUNDING-ROD. WILLIAM H. DIXON, CHICAGO, ILL.

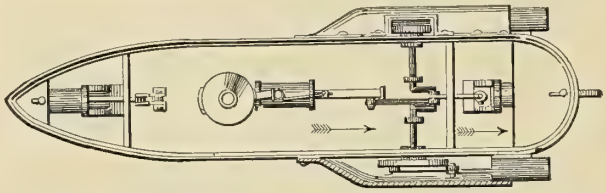
CLAIM.—In a device for the purpose set forth, the combination with the tube having a float arranged therein, an indicating and measuring rod attached to the float, the cap-plate and guide-tube arranged at the upper end of the tube, and the cap adapted to cover the end of the guide-tube, substantially as shown and described.

In a device for the purpose set forth, the combination with a tube having a screen or strainer at the bottom thereof, of a float arranged within the tube and having rollers arranged thereon adjacent to the upper and lower ends of the float, the upwardly projecting rod having a scale or indicating marks thereon, the cap-plate arranged upon the top of the tube, the guide-tube attached to the cap-plate, and having anti-friction rollers at its lower end, and the cap attached to the cap-plate to cover the central opening and the upper end of guide-tube.

688,643. SELF-FEATHERING PADDLE-WHEEL. DAVID W. HORTON, PETERSBURG, IND.

CLAIM.—A feathering paddle-wheel comprising a central shaft having rigid collars, a series of radial arms secured to the collars at their inner ends, said arms being made widest at or near the middle, and converging therefrom outwardly and also inwardly, circular stay-rings bolted to the radial arms at their widest parts, and a series of paddle-blades hinged to the stay-rings between the radical arms and adapted to be supported against the inclined face of either of the extensions of the arms, substantially as and for the purpose described.

688,692. MEANS FOR PROPELLING SHIPS. RICHARD RICHARDS, MIDWAY, KAN.



CLAIM.—The combination with a vessel provided with cylinders on its opposite sides open at their rear ends, of pistons arranged to reciprocate in said cylinders, an engine carried by the vessel, operative mechanism located at the sides of the vessel and connecting the engines with the pistons and shields secured to the sides of the vessel and tapering rearwardly and covering and protecting the operative mechanism connections at the sides of the vessel.